

Work Assignment No. 6  
MTA Agreement No. 15099-0300

## Utica Avenue Transit Improvements Study

# Task 5 Deliverable: Selection of Final Investment Packages

December 2020

Prepared for:



Submitted by:



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*[Note: Appendix 2 is included under separate cover]*

# 1 Executive Summary

This Task 5 report is the culmination of the Utica Avenue Transit Improvements Study (Utica Ave Study). The purpose of the study was to evaluate various modal and alignment options on Utica Ave and capacity improvements in the existing subway network—resulting in the selection of a set of Final Investment Packages for further consideration—to increase mobility and accessibility along, to, and from the Utica Ave corridor for a future horizon year 2035. Alternatives were defined in this study to address the need for transit improvements to increase reliability, reduce travel times, enhance connectivity, and accommodate future growth. In using an alternatives analysis process, the end product of the study was a set of Final Investment Packages corresponding to a range of service concepts and investment levels for transit improvements that addressed the study purpose and need and achieved the study goals and objectives.

The alternatives under consideration in this study included multiple options for a new transit service along the Utica Ave corridor to replace the B46 Select Bus Service (SBS), plus consideration for targeted investments to the A-Division of the subway system that could enhance access to and from the corridor without degrading other A-Division services in Brooklyn.<sup>1</sup> Additionally, a No-Build Alternative was defined as a baseline for comparing the anticipated benefits and potential impacts of the alternatives under consideration through a multi-tiered screening process, which led to the selection of the Final Investment Packages. The overall alternatives development and screening process is shown on Figure ES1,<sup>2</sup> with the work discussed in this report inside the dotted line.

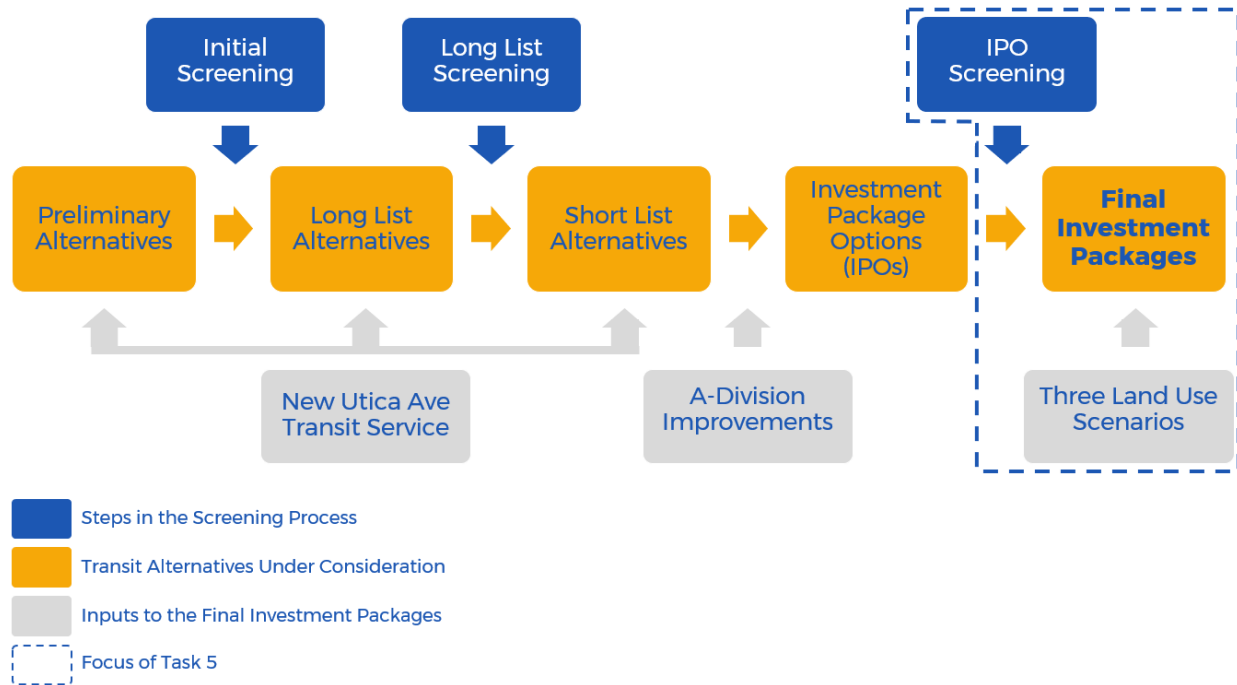
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<sup>1</sup> As noted in Appendix 1 (“Glossary of Key Terms”), the A-Division includes subway services denoted by numbered routes, with the Brooklyn A-Division corresponding to trains that terminate at Flatbush Av Terminal, New Lots Av Terminal, and a terminal along Utica Ave, the location of which would differ among the transit improvement alternatives under consideration in this study. Refer to Appendix 1 for additional high-level descriptions of key terms used in this report.

<sup>2</sup> As depicted on Figure ES1 and discussed in the Task 3 report, the first several steps of the alternatives development and screening process included the definition and evaluation of a range of options for a new transit service along Utica Ave, which led to the identification of the Short List Alternatives. The next step in the process—also documented in the Task 3 report—was to pair the Short List Alternatives for a new transit service along Utica Ave with A-Division improvements (and to consider A-Division improvements without a new transit service along Utica Ave), which were defined as Investment Package Options (IPOs).



Figure ES1: Alternatives Development & Screening Process



Source: Utica Ave Study

Note: The Task 5 work—documented in this report—featured the screening of IPOs and the selection and subsequent ridership evaluation of Final Investment Packages paired with three different Land Use Scenarios, as shown inside the dotted line of this graphic. The preceding steps of the process were documented in the Tasks 3 and 4 deliverables.

As listed in Table ES1, 13 Investment Package Options (IPOs) were defined to comprise a representative set of concepts for new transit service along Utica Ave paired with an associated A-Division operating plan, which differed with respect to the split of peak trains per hour (TPH) by line and terminal. With the exception of IPO #1, all of the other IPOs would include a new transit service along Utica Ave, and most IPOs (including IPO #1) would also include A-Division improvements.<sup>3</sup>

<sup>3</sup>All IPOs with the Modified Hybrid Operating Plan and/or an A-Division Extension (i.e., all IPOs other than #2 and #8) included A-Division improvements as recommended in this study. There were five total A-Division improvements included in the applicable IPOs, and specifically three improvements at Crown Heights-Utica Av Station and one each at Flatbush Av Terminal and New Lots Av Terminal.

Table ES1: Summary of Investment Package Options (IPOs)

New Utica Ave Transit Service		A-Division Operating Plan	
Mode	From/To	CBTC Baseline	Modified Hybrid
N/A	N/A	N/A	IPO #1
BRT	Kings Plaza - Woodhull Hospital	IPO #2	IPO #3
Subway (A-Division Extension)	Kings Plaza - Eastern Parkway (Local Track Connection)	IPO #4	IPO #5
	Kings Plaza - Eastern Parkway (Express Track Connection)	IPO #6	IPO #7
Subway (B-Division Shuttle)	Kings Plaza - Fulton Street (Shuttle) <i>(designed to not preclude a northward extension to Broadway)</i>	IPO #8	IPO #9
BRT & Subway (A-Division Extension)	BRT: Kings Plaza - Woodhull Hospital Subway: Church Av - Eastern Parkway (Local Track Connection) <i>(designed to not preclude a southward extension to Kings Plaza)</i>	IPO #10	IPO #11
	BRT: Kings Plaza - Woodhull Hospital Subway: Church Av - Eastern Parkway (Express Track Connection) <i>(designed to not preclude a southward extension to Kings Plaza)</i>	IPO #12	IPO #13

Source: Utica Ave Study

Notes:

- IPO #1, which would introduce the Modified Hybrid Operating Plan on the A-Division, included a package of improvements to existing A-Division infrastructure.
- All subway IPOs could be fully underground or transition to aerial.

Building upon the work in prior tasks, the screening of IPOs and the resultant selection of the Final Investment Packages—as documented in this report—were informed by a targeted comparison of all 13 IPOs that were under consideration in the study.<sup>4</sup> The comparison was based on a subset of evaluation criteria linked to the study goals and objectives and organized around key themes (i.e., Nostrand Junction operations, service along and to/from Utica Ave, etc.) that allowed decisions to be made among the IPOs.

As discussed in this report, the targeted comparison of the 13 IPOs demonstrated that while several differentiators emerged, no individual IPO performed the best across all metrics. As such, the comparison supported the outcome of this study as a set of Final Investment Packages as opposed to a single locally preferred alternative. The details of the targeted comparison among the 13 IPOs is presented in the main body of this report, as is the specific rationale for the selection of each of the four Final Investment Packages.

<sup>4</sup> The targeted comparison of all 13 IPOs in Task 5 built upon the work in Task 4, which included the ranking of IPOs #4-#7. While no IPOs were eliminated in Task 4, the ranking of IPOs #4-#7 subsequently informed the selection of the Final Investment Packages as documented in this Task 5 report.

As recommended in this report, the Final Investment Packages—and corresponding order-of-magnitude capital cost estimates (in 2020 \$\$)—were as follows:

An important commonality among the four Final Investment Packages is that they all include the Modified Hybrid Operating Plan and thus would eliminate the Nostrand Junction chokepoint, thereby enhancing access to/from Utica Ave and enabling service improvements throughout the Brooklyn A-Division. The Final Investment Packages would also provide a range of modal options—and relative levels of capital investment—for improving mobility along Utica Ave, including BRT, an A-Division Extension (to Kings Plaza), and the pairing of BRT with a partial A-Division Extension (to Church Av). The four Final Investment Packages would differ with respect to the operational characteristics for transit service along Utica Ave as well as on the Brooklyn A-Division to Utica Ave, Flatbush Av Terminal, and New Lots Av Terminal. These operational characteristics served as inputs to the ridership model and were reflected in differences in the resultant ridership forecasts. Appendix 2 presents the corresponding ridership forecasts for each of the four Final Investment Packages paired with each of the three Land Use Scenarios defined earlier in the study.

All of the Final Investment Packages offer opportunities for phased implementation, regardless of whether the respective IPO would feature targeted improvements to the A-Division, a new service along Utica Ave, or both types of improvements. For instance, the A-Division improvements that are common to all of the Final Investment Packages could be constructed sequentially to prioritize the investments at Crown Heights-Utica Av Station that would address critical chokepoints in the system (i.e., at Nostrand Junction) and increase operational flexibility, followed by the complementary improvements to increase terminal capacity at New Lots Av Terminal and Flatbush Av Terminal. Additionally, the IPOs that would introduce a new transit service along Utica Ave could start with an initial operating segment to build ridership prior to implementing the full service. These opportunities for phased implementation could be considered in greater detail in a subsequent design phase for any of the Final Investment Packages.

In summary, the targeted comparison of the IPOs defined in this study led to the selection of four Final Investment Packages, which effectively encompass a wide range of investment levels and concepts for further consideration that could improve transit service along, to, and from Utica Ave.

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<sup>5</sup> The capital cost estimates for the IPOs conservatively assumed a design-bid-build contracting method. The potential efficiencies that could be realized through a design-build contracting method were discussed in “Task 3 Appendix 5: Order-of-Magnitude Capital Cost & Construction Duration Estimates for the IPOs.” For IPOs #5 and #11, the range in capital cost estimates for both the underground and aerial alignment concepts correspond to different options for the Local Track Connection at Eastern Parkway. The specific alignment options could be revisited in a subsequent design phase.

## 2 Introduction

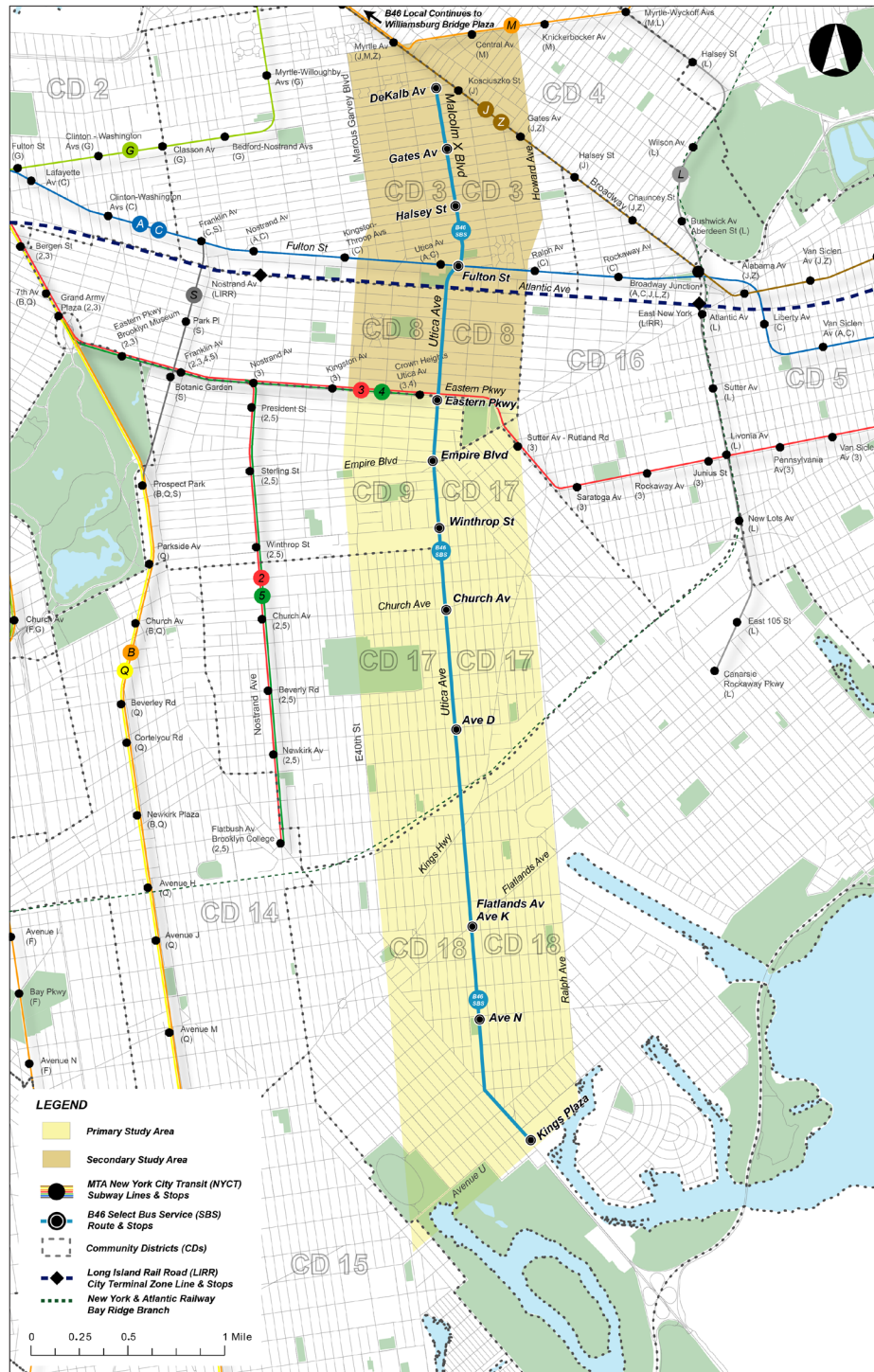
The purpose of the Utica Avenue Transit Improvements Study (Utica Ave Study) was to evaluate various modal and alignment options on Utica Ave and capacity improvements in the existing subway network—resulting in the selection of a set of Final Investment Packages for further consideration—to increase mobility and accessibility along, to, and from the Utica Ave corridor for a future horizon year 2035. Alternatives were defined in this study to address the need for transit improvements to increase reliability, reduce travel times, enhance connectivity, and accommodate future growth. In using an alternatives analysis process, the end product of the study was a set of Final Investment Packages corresponding to a range of service concepts and investment levels for transit improvements that addressed the study purpose and need and achieved the study goals and objectives.

This Task 5 report is the culmination of the Utica Ave Study. Building upon the work in preceding tasks, this report presents the results of the screening of Investment Package Options (IPOs) and the selection of the Final Investment Packages. Appendix 1 includes a ridership evaluation of the Final Investment Packages paired with each of the three Land Use Scenarios defined earlier in the study.

## 3 Study Area

As shown on Figure 1, the Study Area for the Utica Ave Study extended from Avenue V in the south to Myrtle Avenue in the north, incorporating an approximately half-mile buffer around the Utica Ave corridor, which becomes Malcolm X Boulevard north of Fulton Street. The Study Area was divided into Primary and Secondary Study Areas. The Primary Study Area was bounded by Eastern Parkway to the north, Ralph Avenue to the east, Avenue V to the south, and East 40th Street to the west. This area served as the main focus in the study of options to improve transit service and mobility along the Utica Avenue corridor. A Secondary Study Area contained additional opportunities for transit improvements along the northern portion of the corridor, extending from the Primary Study Area's northern boundary to Myrtle Avenue, which is several blocks north of the terminus for the existing B46 Select Bus Service (SBS).

Figure 1: Utica Ave Study Area



Source: Utica Ave Study

## 4 Summary of Alternatives Development & Screening Process

The transit improvement alternatives under consideration in this study included multiple options covering multiple modes for a new service along the Utica Ave corridor, plus consideration for targeted investments to the A-Division of the subway system that could enhance access to and from the corridor.<sup>6</sup> Additionally, a No-Build Alternative was defined as a baseline for comparing the anticipated benefits and potential impacts of the Build Alternatives through a multi-tiered screening process.<sup>7</sup> The following sections present an overview of the types of transit improvements under consideration in this study and the screening process that was used to inform the selection of Final Investment Packages.

### 4.1 BACKGROUND: TYPES OF TRANSIT IMPROVEMENTS UNDER CONSIDERATION

As depicted on Figure 2, Utica Ave transit improvements could come in two forms:

- Improving mobility along Utica Ave by introducing a new transit service to replace the existing B46 SBS; and
- Improving access to/from Utica Ave through targeted investments to the A-Division (while avoiding a degradation of other A-Division services in Brooklyn).

The Build Alternatives for the first type of transit improvement (i.e., along Utica Ave) included a number of different modal and alignment options for a new transit service, including combinations of potential northern and southern termini as well as variants based on operational/design characteristics. The study also identified options to improve transit access to/from Utica Ave by increasing the existing A-Division capacity and operational flexibility in eastern Brooklyn.<sup>8</sup> This included opportunities along the Eastern Parkway, New Lots Avenue, and Nostrand Avenue Lines of the subway to alleviate existing constrained conditions pertaining to train operation bottlenecks and shortage of train storage or lay-up capability. The A-Division locations are shown on Figure 2 and correspond to Nostrand Junction, Flatbush Av Terminal, Crown Heights-Utica Av Station, New Lots Av Terminal, and Livonia and Linden Yards.

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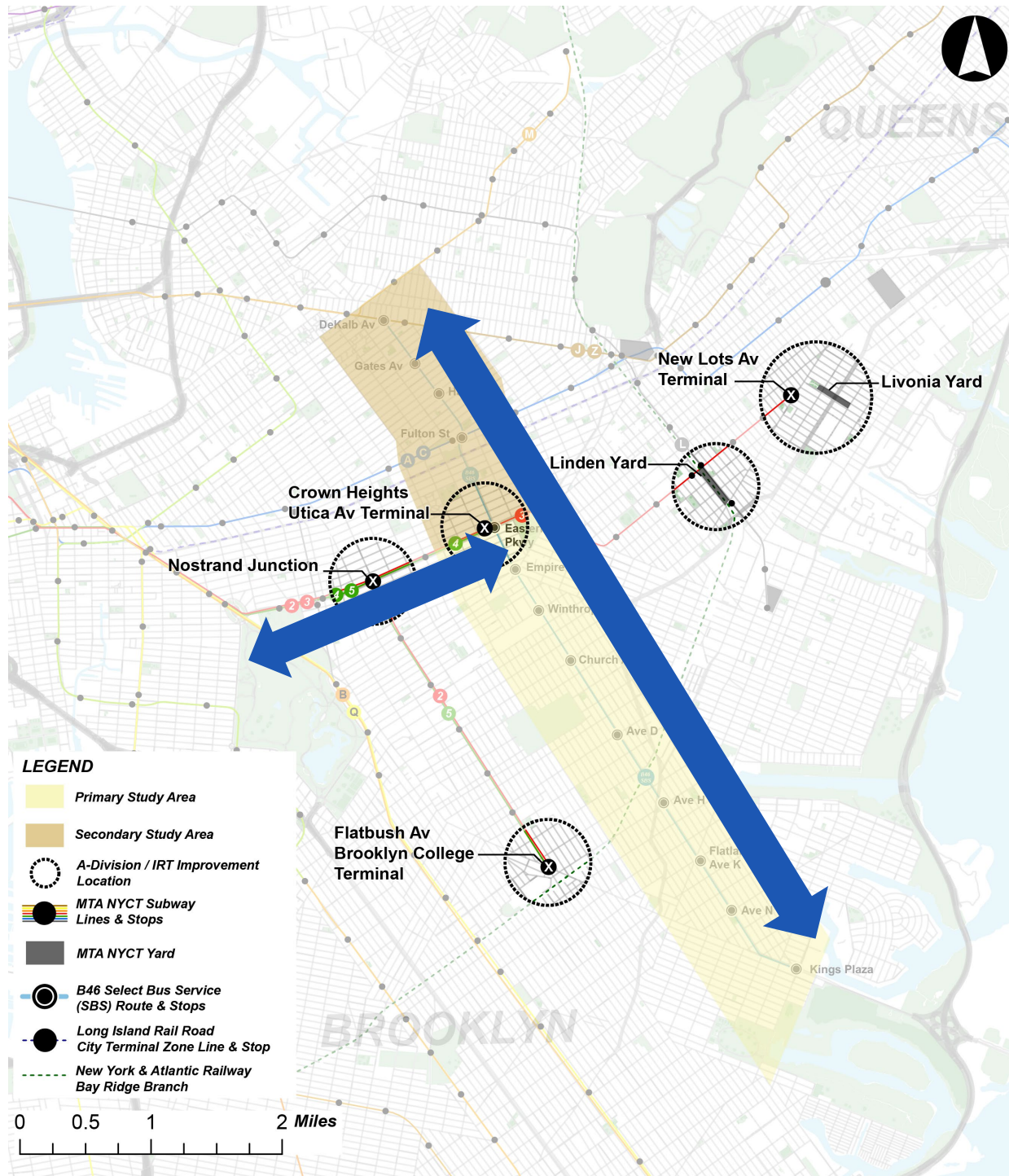
<sup>6</sup> As noted in Appendix 1 (“Glossary of Key Terms”), the A-Division includes subway services denoted by numbered routes, with the Brooklyn A-Division corresponding to trains that terminate at Flatbush Av Terminal, New Lots Av Terminal, and a terminal along Utica Ave, the location of which would differ among the transit improvement alternatives under consideration in this study. Refer to Appendix 1 for additional high-level descriptions of key terms used in this report.

<sup>7</sup> The No-Build Alternative was defined to include transportation network improvements expected to exist in the 2035 horizon year. For instance, the No-Build Alternative included Long Island Rail Road (LIRR) East Side Access, Metro-North Railroad Penn Station Access, and Phase 2 of the Second Avenue Subway. The No-Build Alternative also included improvements to travel times and average headways on the A-Division due to the installation of Communications-Based Train Control (CBTC), as well as a number of capital improvements and operational changes to enhance the existing B46 SBS. Additional details about the No-Build Alternative were included in the Task 3 report.

<sup>8</sup> As discussed in Section 4.2, the first several steps of the screening process focused on evaluating options for a new transit service along Utica Ave, followed by consideration of A-Division improvements.



Figure 2: Opportunities for Transit Improvements Along and To/From Utica Ave



Source: Utica Ave Study

Note: Opportunities for transit improvements along and to/from Utica Ave are denoted by bold arrows

Both types of improvements (i.e., a new transit service on Utica Ave and targeted investments to the A-Division) could have independent utility by enhancing service along or to/from Utica Ave. The improvements could also be complementary, with possible synergies generating additional benefits, for instance with respect to travel time savings and ridership potential. The result of the study—documented in this report—was the selection of Final Investment Packages, each of which could include one or both types of improvements, as discussed in the next section.

## 4.2 SCREENING PROCESS TO INFORM SELECTION OF FINAL INVESTMENT PACKAGES

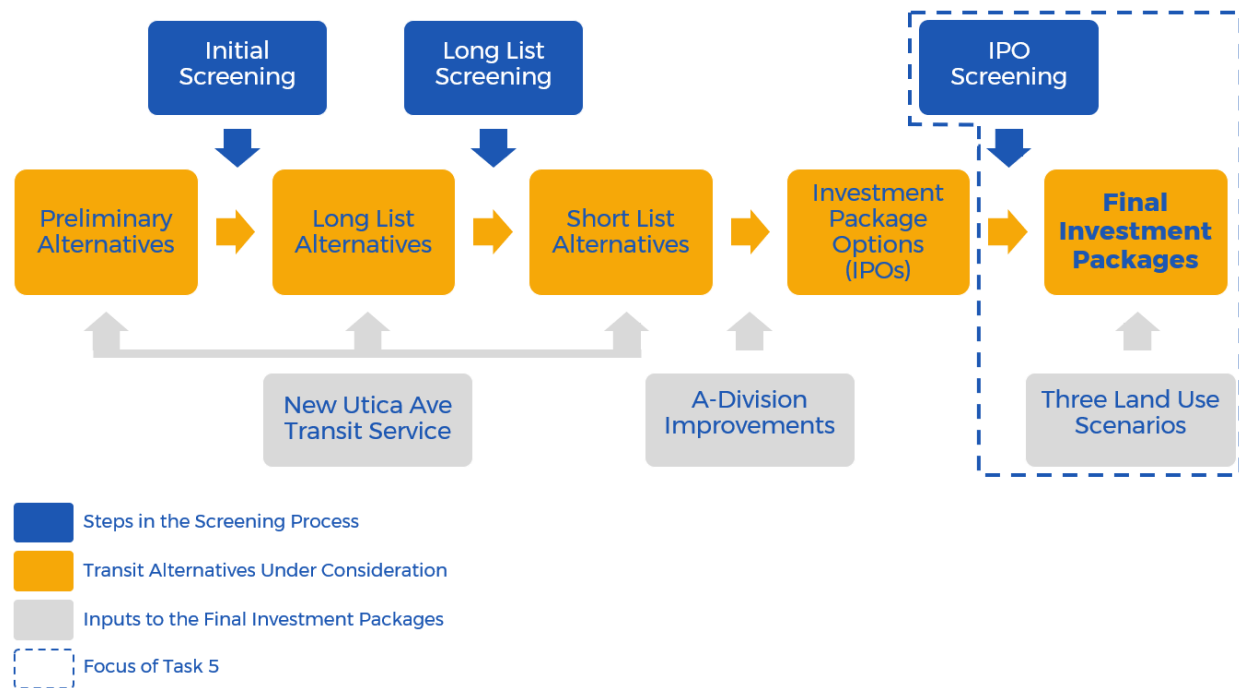
The Utica Ave Study included a multi-tiered screening process to evaluate the wide range of alternatives under consideration for a new transit service along Utica Ave, ultimately leading to the identification of multiple Final Investment Packages—with consideration for improvements to the A-Division—that met the study goals and objectives. The study goals and objectives provided the foundation for the evaluation of alternatives to achieve the purpose and need. The study goals were as follows:

1. Improve mobility and connectivity through the provision of new or enhanced transit options
2. Maximize consistency with local and regional plans
3. Enhance access to employment and activity centers and support economic growth
4. Maximize operational and cost effectiveness
5. Minimize adverse environmental impacts
6. Promote a resilient and redundant transit network

At each stage of the multi-tiered screening process, evaluation criteria were defined and applied to compare the extent to which the alternatives achieved the study goals and objectives. The alternatives development and screening process is shown on Figure 3, with the work discussed in this report inside the dotted line.



Figure 3: Alternatives Development & Screening Process



Source: Utica Ave Study

Note: The Task 5 work—documented in this report—featured the screening of IPOs and the selection and subsequent ridership evaluation of Final Investment Packages paired with three different Land Use Scenarios, as shown inside the dotted line of this graphic. The preceding steps of the process were documented in the Tasks 3 and 4 deliverables.

As discussed in the Task 3 report and depicted on Figure 3, the first several steps of the alternatives development and screening process led to the definition of a set of Investment Package Options (IPOs), which included consideration of the Short List Alternatives for a new transit service along Utica Ave as well as A-Division improvements. The selection of the Final Investment Packages—documented in this report—was informed by the screening of IPOs, which is discussed in the following section and incorporated the results of the Task 4 work. Appendix 2 to this Task 5 report includes the evaluation of ridership potential of the Final Investment Packages using three different Land Use Scenarios that corresponded to incremental increases in population and employment along the corridor in the 2035 horizon year.

Overall, while generally following an alternatives analysis process, the study did not identify a single locally preferred alternative (LPA), but rather a number of Final Investment Packages that reflected a range of investment levels and options for improving transit along, to, and from Utica Ave.<sup>9</sup>

<sup>9</sup> As discussed in Section 6.3, a targeted comparison of the 13 IPOs (using a subset of evaluation criteria linked to the study goals and objectives) demonstrated that while several differentiators emerged, no individual IPO performed the best across all metrics. As such, the comparison supported the outcome of this study as a set of Final Investment Packages as opposed to a single LPA.

## 5 Overview of Investment Package Options (IPOS)

As discussed in the Task 3 report, 13 IPOs were defined that built upon the Short List Alternatives and comprised a representative set of concepts for new transit service along Utica Ave paired with an associated A-Division operating plan (Table 1). The options for new service along Utica Ave are shown on Figure 4 through Figure 7, and Table 2 presents the A-Division operating plan—specifically the split of peak trains per hour (TPH) by line and terminal—for each of the 13 IPOs.<sup>10</sup>

Table 1: Summary of Investment Package Options (IPOS)

New Utica Ave Transit Service		A-Division Operating Plan	
Mode	From/To	CBTC Baseline	Modified Hybrid
N/A	N/A	N/A	IPO #1
BRT	Kings Plaza - Woodhull Hospital	IPO #2	IPO #3
Subway (A-Division Extension)	Kings Plaza - Eastern Parkway (Local Track Connection)	IPO #4	IPO #5
	Kings Plaza - Eastern Parkway (Express Track Connection)	IPO #6	IPO #7
Subway (B-Division Shuttle)	Kings Plaza - Fulton Street (Shuttle) <i>(designed to not preclude a northward extension to Broadway)</i>	IPO #8	IPO #9
BRT & Subway (A-Division Extension)	BRT: Kings Plaza - Woodhull Hospital Subway: Church Av - Eastern Parkway (Local Track Connection) <i>(designed to not preclude a southward extension to Kings Plaza)</i>	IPO #10	IPO #11
	BRT: Kings Plaza - Woodhull Hospital Subway: Church Av - Eastern Parkway (Express Track Connection) <i>(designed to not preclude a southward extension to Kings Plaza)</i>	IPO #12	IPO #13

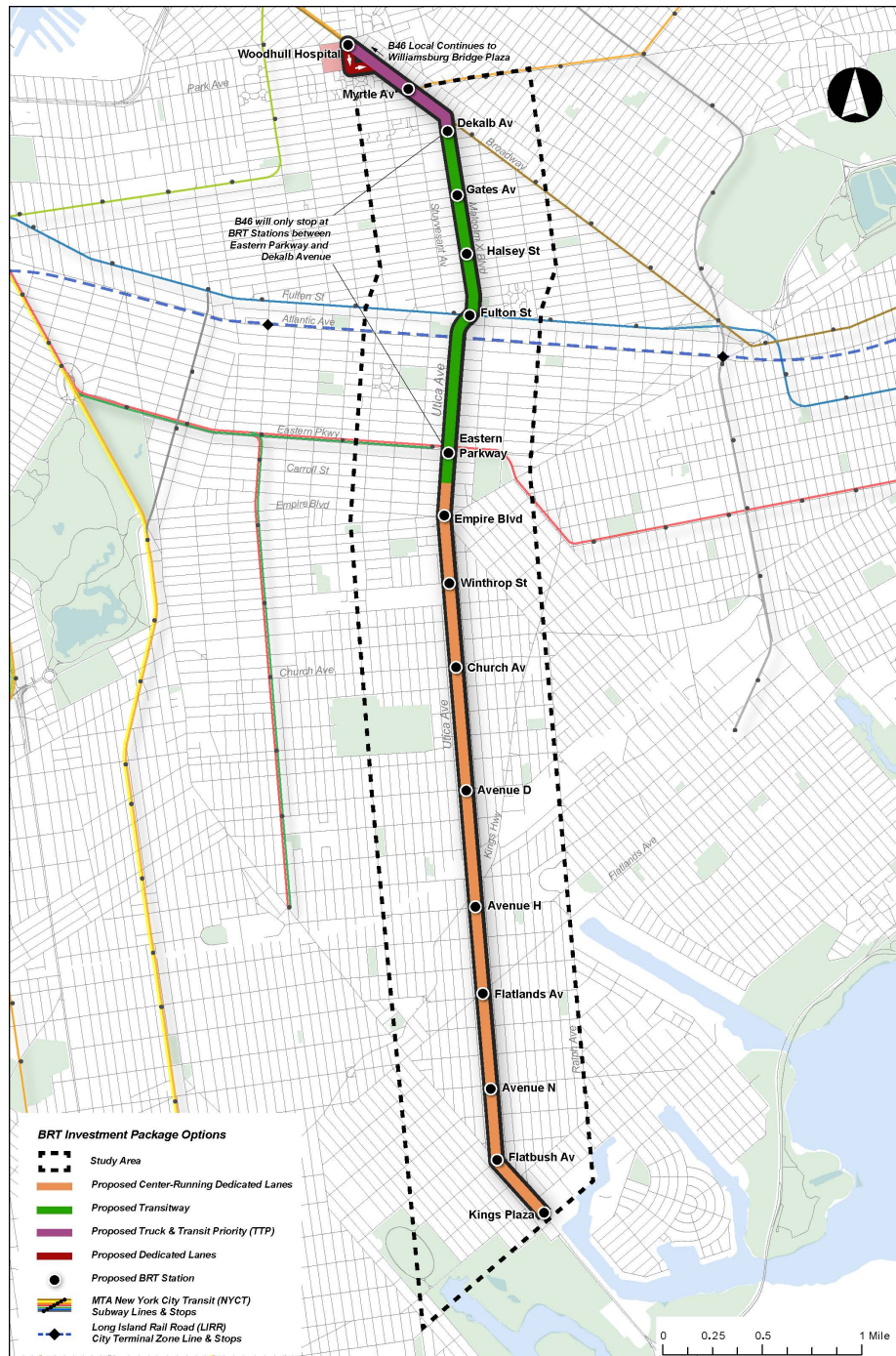
Source: Utica Ave Study

Notes:

- IPO #1, which would introduce the Modified Hybrid Operating Plan on the A-Division, included a package of improvements to existing A-Division infrastructure.
- All subway IPOs could be fully underground or transition to aerial.

<sup>10</sup> Additional details about the 13 IPOs—including operational assumptions—were presented in a set of Task 3 Appendices.

Figure 4: IPOs #2 - #3: Bus Rapid Transit (BRT) Along Utica Ave



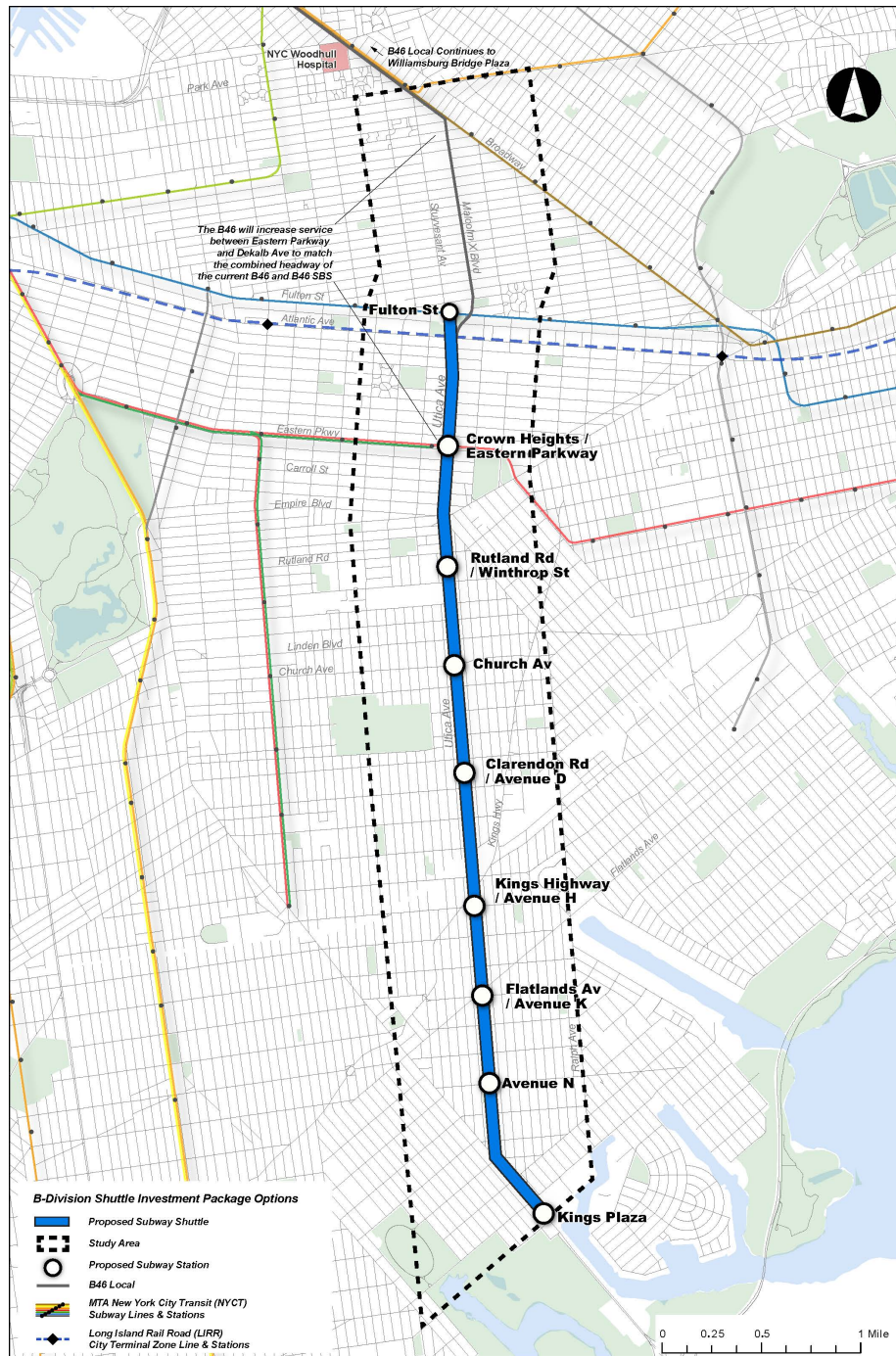
Source: Utica Ave Study

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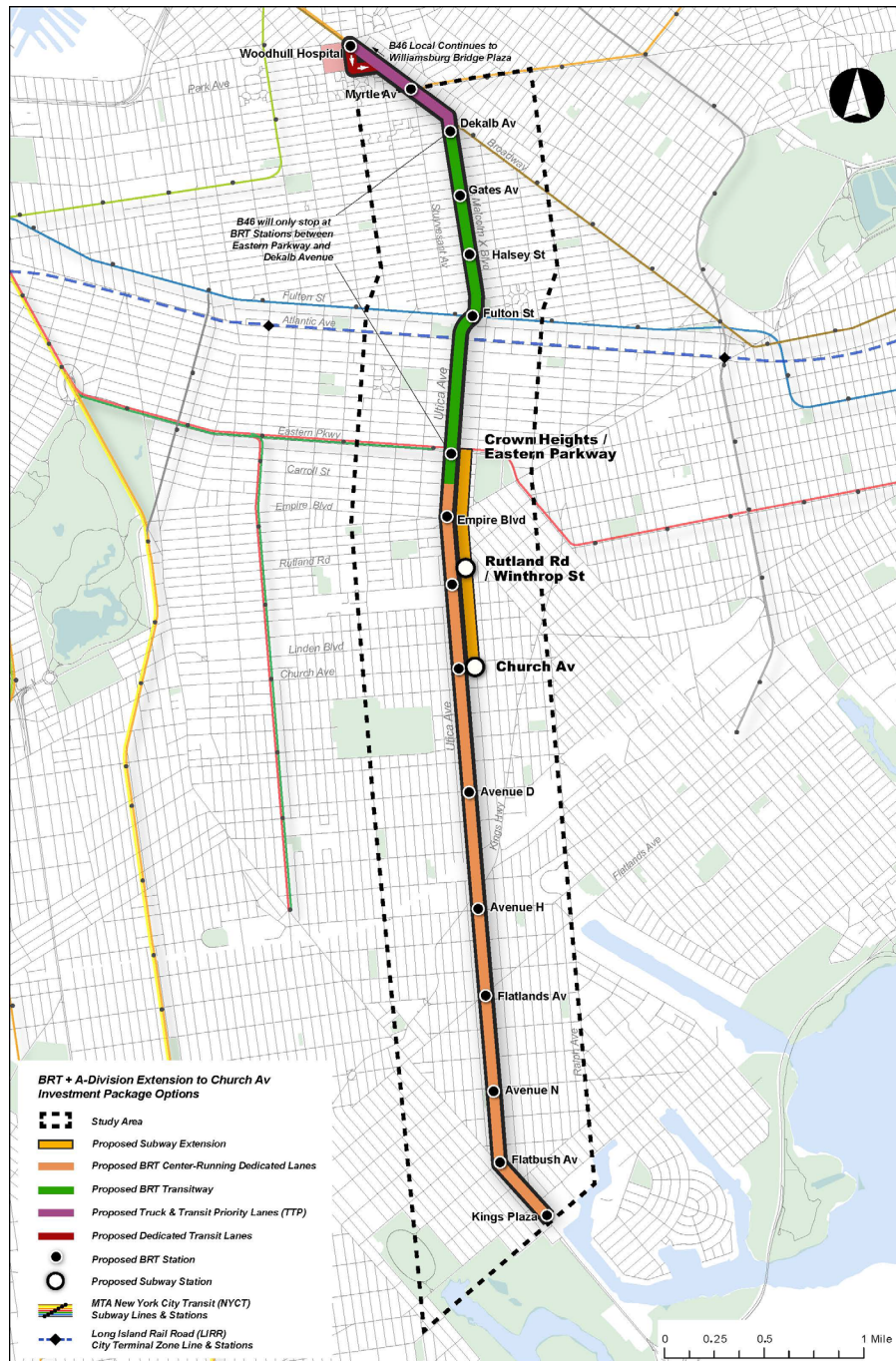
Figure 6: IPOs #8 - #9: B-Division Shuttle Along Utica Ave



Source: Utica Ave Study

Note: Designed to not preclude a future northward extension to Broadway

Figure 7: IPOs #10 - #13: BRT + Partial A-Division Extension Along Utica Ave



Source: Utica Ave Study

Note: A-Division Extension designed to not preclude a future southward extension to Kings Plaza

Table 2: A-Division Operating Plans for the 13 IPOs

IPO #	Description	Peak Trains Per Hour (TPH) by Line and Southern Terminal (for Brooklyn A-Division)				Total TPH, All Lines & Terminals
		To Flatbush Av	To Crown Heights-Utica Av	To Kings Plaza (or Church Av)	To New Lots Av	
- No-Build - IPO #2 - IPO #8	No-Build Alternative for A-Division (CBTC Baseline Operating Plan <i>without</i> an A-Division Extension)	②: 13 TPH ⑤: 7 TPH (Total: 20 TPH)	④: 13 TPH ⑤: 6 TPH (Total: 19 TPH)*	N/A	③: 13 TPH (Total: 13 TPH)	52 TPH*, **
- IPO #1 - IPO #3 - IPO #9	A-Division Improvements <i>without</i> an A-Division Extension (Modified Hybrid Operating Plan <i>without</i> an A-Division Extension)***	②: 12 TPH ③: 12 TPH (Total: 24 TPH)	④: 20 TPH (Total: 20 TPH)	N/A	⑤: 10 TPH ⑧: 6 TPH (Total: 16 TPH)	60 TPH
- IPO #4 (to Kings Plaza) - IPO #10 (to Church Av)	A-Division Extension Build Alternatives	Local Track Connection with CBTC Baseline Operating Plan	②: 13 TPH ⑤: 7 TPH (Total: 20 TPH)	N/A	③: 13 TPH (Total: 13 TPH) ④: 23 TPH (Total: 23 TPH)	56 TPH
- IPO #6 (to Kings Plaza) - IPO #12 (to Church Av)		Express Track Connection with CBTC Baseline Operating Plan	②: 13 TPH ⑤: 7 TPH (Total: 20 TPH)	N/A	④: 23 TPH (Total: 23 TPH) ③: 13 TPH (Total: 13 TPH)	56 TPH
- IPO #5 (to Kings Plaza) - IPO #11 (to Church Av)		Local Track Connection with Modified Hybrid Operating Plan***	②: 12 TPH ③: 12 TPH (Total: 24 TPH)	N/A	④: 7 TPH ⑤: 10 TPH ⑧: 6 TPH (Total: 23 TPH) ④: 13 TPH (Total: 13 TPH)	60 TPH
- IPO #7 (to Kings Plaza) - IPO #13 (to Church Av)		Express Track Connection with Modified Hybrid Operating Plan***	②: 12 TPH ③: 12 TPH (Total: 24 TPH)	N/A	④: 20 TPH ⑤: 3 TPH (Total: 23 TPH)* ⑤: 7 TPH ⑧: 6 TPH (Total: 13 TPH)*	60 TPH

Source: Utica Ave Study

Notes:

\*This table shows the TPH by line and southern terminal for the ridership forecasts. Below is a summary of differences from the rail simulations:

-No-Build Alternative: To Crown Heights-Utica Av = 23 TPH for ④ and 0 TPH for ⑤ (total 23 TPH); Total TPH, All Lines &amp; Terminals = 56 TPH

-IPO #7: To Kings Plaza (or Church Av) = 20 TPH for ④ and 0 TPH for ⑤ (total 20 TPH); To New Lots Av = 10 TPH for ⑤ and 6 TPH for ⑧ (total 16 TPH)

\*\* An additional 3 TPH combined for the East Side IRT would terminate in Manhattan (with the Bronx -Bowling Green short-turn) for the No-Build Alternative.

\*\*\*The Modified Hybrid Operating Plan would introduce a new ⑧ line to enable West Side service to New Lots Av Terminal (for the Express Track Connection) or along Utica Ave (for the Local Track Connection).

The 13 IPOs included the following modal options for new service along Utica Ave:

- **Bus Rapid Transit (BRT)**, which would comprise full physical separation from traffic, thereby improving travel time for customers by avoiding problems that degrade B46 SBS service (e.g., double parking and bus bunching). Additionally, the BRT would provide service to both the Myrtle Av Subway Station and Woodhull Hospital, beyond the northern terminus of the B46 SBS.
- **A-Division Extension**, which would comprise a subway extension south along Utica Ave from Crown Heights-Utica Av Station with through service that would enable a one-seat ride from Utica Ave to/from Manhattan and other locations along the A-Division. Several options for an A-Division Extension were included in the 13 IPOs, including different combinations of the track connection at Eastern Parkway, the A-Division operating plan, and the southern terminus along Utica Ave.
- **B-Division Shuttle**, which would comprise an option to provide subway service along Utica Ave to Fulton Street (with the prospect of a future northward extension to Broadway) because a B-Division Extension with through service was deemed to be fatally flawed earlier in the study due to capacity constraints. The B-Division Shuttle concept would constitute an isolated line in which customers would be required to transfer to access other subway services.

As shown in Table 2, the A-Division operating plans that were advanced in this study offered different services to Flatbush Av Terminal, New Lots Av Terminal, and a terminal along Utica Ave, the location of which would differ among the IPOs (i.e., Crown Heights-Utica Av Station, Church Av, or Kings Plaza). Without an A-Division Extension along Utica Ave, the Communications-Based Train Control (CBTC) Baseline Operating Plan corresponded to the No-Build Alternative for A-Division operations.<sup>11</sup> The Modified Hybrid Operating Plan—enabled by A-Division improvements—would accommodate an increase in peak service delivery on the Brooklyn A-Division compared to the CBTC Baseline Operating Plan. Additionally, when paired with an A-Division Extension, the Modified Hybrid Operating Plan would introduce a new **8** line to enable West Side service to New Lots Av Terminal (for the Express Track Connection) or along Utica Ave (for the Local Track Connection).

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<sup>11</sup> CBTC corresponds to a signaling system that offers train dispatchers more accurate train location information, allows for closer spacing between trains, enables increased reliability, and has the potential to increase the number of trains running on each line compared to fixed-block signaling. The No-Build Alternative in this study included the installation of CBTC on the A-Division.



As indicated in Table 2, several IPOs included the same split of TPH by line and terminal as reflected in the A-Division operating plan, as follows:

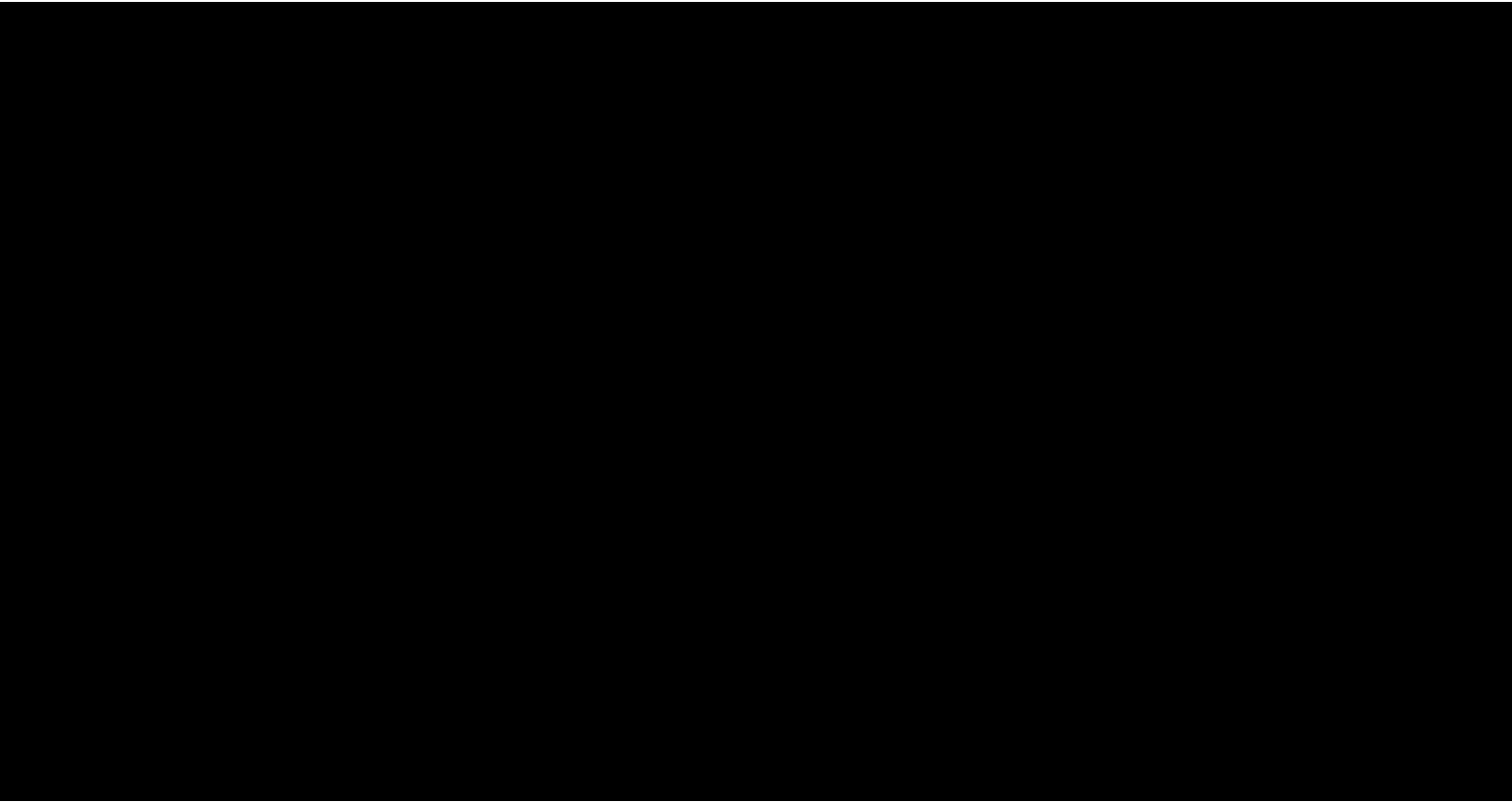
- IPOs #2 and #8 both included the CBTC Baseline Operating Plan without an A-Division Extension, which was the same as the No-Build Alternative, and these two IPOs differed with respect to the new service along Utica Ave (i.e., BRT and B-Division Shuttle, respectively);
- IPOs #1, #3, and #9 all included the Modified Hybrid Operating Plan without an A-Division Extension, and these three IPOs differed with respect to the new service along Utica Ave (i.e., no new service, BRT, and B-Division Shuttle, respectively);
- IPOs #4 and #10 both included the CBTC Baseline Operating Plan with an A-Division Extension via a Local Track Connection at Eastern Parkway, and these two IPOs differed with respect to the southern terminus of the A-Division Extension (i.e., Kings Plaza and Church Av, respectively) and the fact that IPO #10 also included BRT in addition to the A-Division Extension;
- IPOs #5 and #11 both included the Modified Hybrid Operating Plan with an A-Division Extension via a Local Track Connection at Eastern Parkway, and these two IPOs differed in the same way as IPOs #4 and #10 as noted above;
- IPOs #6 and #12 both included the CBTC Baseline Operating Plan with an A-Division Extension via an Express Track Connection at Eastern Parkway, and these two IPOs differed in the same way as IPOs #4 and #10 as noted above; and
- IPOs #7 and #13 both included the Modified Hybrid Operating Plan with an A-Division Extension via an Express Track Connection at Eastern Parkway, and these two IPOs differed in the same way as IPOs #4 and #10 as noted above.

With the exception of IPO #1 (which corresponded to A-Division improvements only, supplementing the B46 SBS along Utica Ave), all of the other IPOs would include a new transit service along Utica Ave. Additionally, most IPOs would include A-Division improvements, and specifically all IPOs with the Modified Hybrid Operating Plan and/or an A-Division Extension (i.e., IPOs #1, #3, #4-#7, #9, and #10-#13). The remaining IPOs—namely, those IPOs with the CBTC Baseline Operating Plan and without an A-Division Extension (i.e., IPOs #2 and #8)—would not include A-Division improvements.<sup>12</sup>

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<sup>12</sup> As discussed in the Task 3 report, the rationale for this distinction was that unlike all other IPOs, IPOs #2 and #8 would comprise a new transit service along Utica Ave (i.e., BRT and a B-Division Shuttle, respectively) that would not be dependent upon any A-Division improvements. Therefore, and as documented in Section 6.3 of this report, it was possible to compare the relative benefits of IPOs #2 and #8 against IPOs #3 and #9, respectively, which included the same service along Utica Ave but also paired with the A-Division improvements.

There were five total A-Division improvements included in the applicable IPOs, and specifically three improvements at Crown Heights-Utica Av Station and one each at Flatbush Av Terminal and New Lots Av Terminal (Figure 8). As discussed in the Task 3 report, this package of complementary investment [REDACTED] would increase capacity for the overall Brooklyn A-Division,<sup>13</sup> increase terminal capacity, add operational flexibility, and add train storage capacity.



Source: Utica Ave Study

Following the definition of the IPOs to comprise a transit service concept along Utica Ave and a corresponding A-Division operating plan, the screening of the IPOs led to the selection of the Final Investment Packages, as discussed in the following sections.

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<sup>13</sup> Capacity for the overall Brooklyn A-Division corresponds to the total TPH combined for all lines terminating along Utica Ave and those terminating at Flatbush Av and New Lots Av.

## 6 IPO Screening and Selection of Final Investment Packages

Building upon the multi-tiered screening process that informed the definition of the IPOs, the subsequent screening of the IPOs was similarly completed in multiple steps. The work in previous tasks provided the inputs to the targeted comparison of the 13 IPOs—as documented in this report—that resulted in the selection of the Final Investment Packages. The following sections present an overview of the IPO screening methodology, a recap of the Task 4 outcome, and the results of the work in Task 5 to select the Final Investment Packages.

### 6.1 IPO SCREENING METHODOLOGY

Following the definition of the 13 IPOs, a set of quantitative and qualitative evaluation criteria—linked to the study goals and objectives—was established to inform the selection of Final Investment Packages from the IPOs. All of the evaluation criteria were important and collectively demonstrated the extent to which each IPO achieved the study goals and objectives against the baseline of the No-Build Alternative. There were 35 evaluation criteria in total, and a subset of the criteria was identified that would drive the recommendations for the Final Investment Packages. These criteria and the corresponding goals and objectives were listed in the Task 3 report.

The technical work to support the evaluation of IPOs was completed and documented in the Task 3 report, and the screening of the IPOs to inform the selection of the Final Investment Packages was completed in two steps, as follows:

- Task 4: ranking of IPOs #4-#7 based on the applicable criteria for comparing different operational scenarios of an A-Division Extension along Utica Ave from Eastern Parkway to Kings Plaza; and
- Task 5 (documented in this report): selection of the Final Investment Packages as informed by the ranking of IPOs #4-#7 in Task 4, the evaluation of all 13 IPOs, and the intent to offer a range of investment levels and service concepts for the Utica Ave transit improvements. This task also included ridership forecasts for the Final Investment Packages paired with three potential future Land Use Scenarios.

The following section summarizes the outcome of Task 4 as a precursor to presenting the work in Task 5, which led to the selection of the Final Investment Packages.

## 6.2 RECAP OF TASK 4: RANKING OF IPOs #4-#7

As introduced in a previous section of this report, IPOs #4-#7 all featured an A-Division Extension to Kings Plaza but included different combinations of the track connection at Eastern Parkway (Local or Express) and the corresponding operating plan (CBTC Baseline or Modified Hybrid), reflected in different splits of peak TPH both by line and by terminal for the Brooklyn A-Division services. As discussed in the Task 4 report, there were several key drivers that informed the resultant ranking of IPOs #4-#7, which subsequently informed the work in Task 5.

A fundamental differentiator among the four IPOs was that IPOs #5 and #7 would be preferable because they eliminate the Nostrand Junction chokepoint, whereas IPOs #4 and #6 do not.<sup>14</sup> In comparing IPOs #5 and #7, IPO #5 emerged as a more favorable option based on several metrics, including end terminal on-time performance (OTP) to Kings Plaza, end terminal OTP for the overall Brooklyn A-Division, and the fact that this was the only IPO that would offer a one-seat ride from Kings Plaza to both the East Side and West Side of Manhattan. For these reasons, IPO #5 was identified as the top ranked IPO among the four IPOs and IPO #7 was ranked second.

IPO #4 was the least attractive option among the four IPOs because it would result in a reduction in service frequency from Kings Plaza compared to the B46 SBS in the No-Build Alternative. Although IPO #4 performed better than IPO #6 for most metrics, the reduction in service frequency associated with IPO #4 rendered this option the least preferable among IPOs #4-#7. As such, IPO #6 was ranked third and IPO #4 was ranked fourth among the four IPOs.

In summary, the recommended ranking of IPOs #4-#7 was as follows:

- **First: IPO #5** (Local Track Connection with Modified Hybrid Operating Plan);
- **Second: IPO #7** (Express Track Connection with Modified Hybrid Operating Plan);
- **Third: IPO #6** (Express Track Connection with CBTC Baseline Operating Plan); and
- **Fourth: IPO #4** (Local Track Connection with CBTC Baseline Operating Plan).

This ranking of IPOs #4-#7 informed the subsequent comparison of all 13 IPOs and the resultant selection of the Final Investment Packages.

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<sup>14</sup> The Nostrand Junction chokepoint is discussed in the context of all 13 IPOs in Section 6.3 of this report.

### 6.3 TARGETED COMPARISON OF ALL 13 IPOs

Building upon the work in Task 4, the targeted comparison of all 13 IPOs was organized around key themes (i.e., Nostrand Junction operations, service along and to/from Utica Ave, etc.) that emerged from the subset of evaluation criteria and allowed decisions to be made among the IPOs.

To provide background context, the comparison of the 13 IPOs started with an assessment of the extent to which each IPO would serve Environmental Justice (EJ) communities, corresponding to areas of relatively large percentages of minority and/or low-income populations. Several additional metrics helped to differentiate the 13 IPOs, such as the overarching consideration of addressing the chokepoint at Nostrand Junction. The comparison also considered operational metrics associated with the provision of service both along and to/from Utica Ave,<sup>15</sup> including implications for other Brooklyn A-Division services (i.e., to/from Flatbush Av Terminal and New Lots Av Terminal). Additionally, ridership forecasts, order-of-magnitude cost estimates, and the corresponding assessment of cost effectiveness also informed the comparison of the 13 IPOs.

The following sections present the results of these comparisons, followed by the recommendations for the Final Investment Packages. The metrics for each IPO are color-coded for ease of reference relative to the No-Build Alternative (if applicable), and specifically to differentiate between positive and negative changes compared to the No-Build Alternative.

#### Transit Service to EJ Communities

As discussed in a Task 3 Appendix,<sup>16</sup> both the Primary and Secondary Study Areas are considered EJ communities with respect to minority population. Additionally, as shown on Figure 9, the majority of the census tracts that comprise the Study Area are predominantly minority. The Secondary Study Area is also considered an EJ community with respect to low-income population, and a number of individual census tracts within the northern portion of the Primary Study Area similarly constitute EJ communities with respect to low-income population.

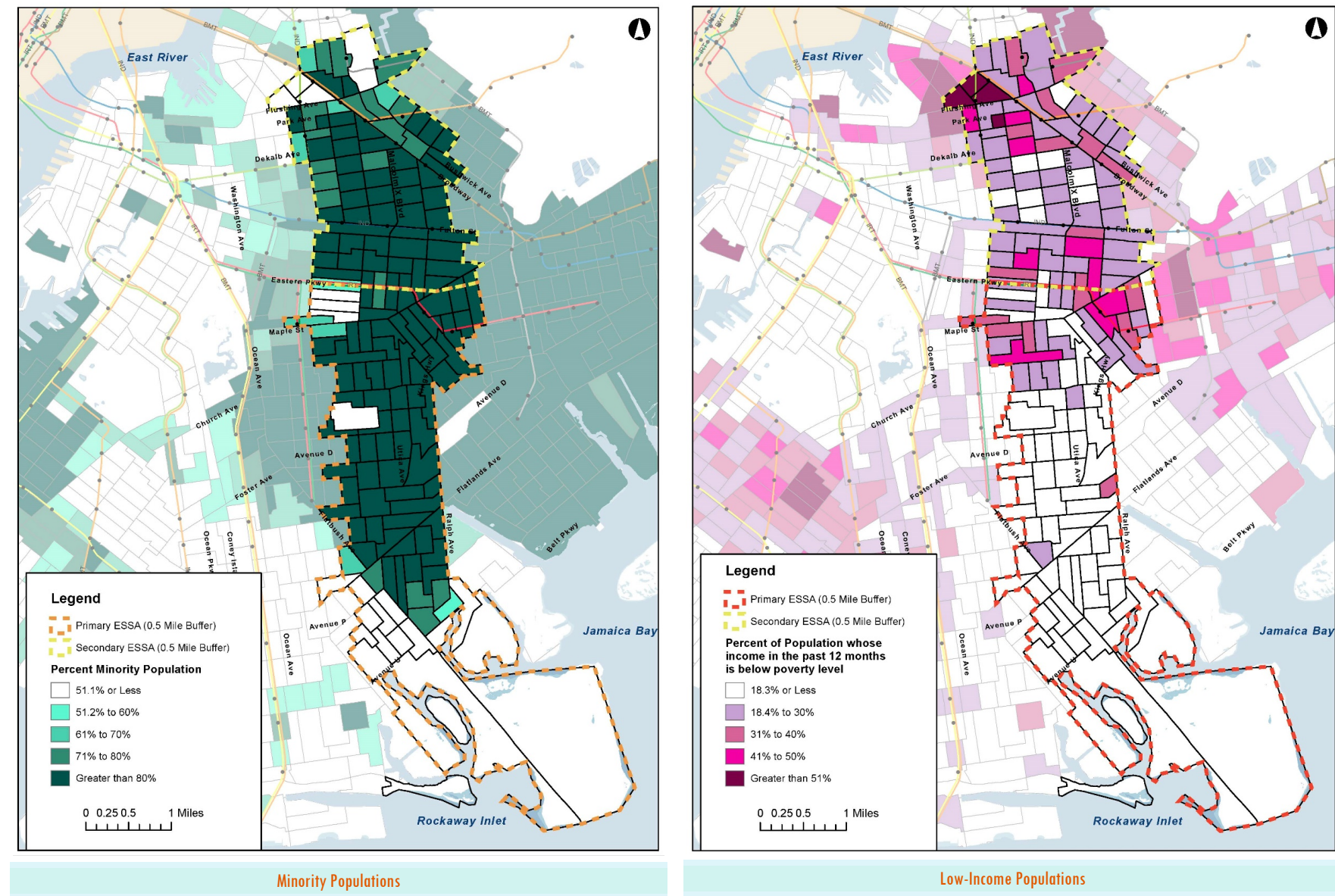
Based on this socioeconomic and demographic composition of both the Primary and Secondary Study Areas, all 13 of the IPOs would serve EJ communities, albeit in different ways. For instance, with the exception of IPO #1, all of the IPOs would introduce a new service along Utica Ave and thereby serve EJ communities along different portions of the corridor. Additionally, all IPOs with the Modified Hybrid Operating Plan and/or an A-Division Extension (i.e., all except IPOs #2 and #8) would serve EJ communities by improving A-Division service.

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<sup>15</sup> It is important to note that different IPOs would have different A-Division terminal locations on Utica Ave. For the No-Build Alternative and IPOs #1-#3 and #8-#9, the service would terminate at Crown Heights-Utica Av Station; for IPOs #4-#7, the service would terminate at Kings Plaza; and for IPOs #10-#13, the service would terminate at Church Av.

<sup>16</sup> Refer to "Task 3 Appendix 7: Environmental Scan Along Utica Ave" for more information, including details about the methodology for defining EJ communities based on federal and state guidance.

Figure 9: EJ Communities in the Study Area



Source: American Community Survey 2014-2018, Utica Ave Study



There were also more nuanced differences among how the IPOs would serve EJ communities, including operational and geographic differences. For instance, the IPOs differed with respect to the transit mode and corresponding operational characteristics for the new service along Utica Ave. As discussed in a subsequent section of this report, the different options under consideration for a new service along Utica Ave would offer different service frequencies, travel time savings, reliability improvements, and implications for connectivity to the East and West Sides of Manhattan, among other factors. Additionally, the IPOs differed with respect to the service areas that would benefit from the new service along Utica Ave. Whereas IPOs #2-#3 and #10-#13 would introduce a new service that runs along the entire B46 SBS route and includes a route extension to Woodhull Hospital, the new service associated with IPOs #4-#7 and #8-#9 would serve the corridor from Kings Plaza to Eastern Parkway and Fulton Street, respectively.

The IPOs also differed with respect to changes in underlying bus service and corresponding tradeoffs, which would have different implications for serving EJ communities along the corridor. With the exception of IPO #1, all IPOs would replace the B46 SBS with a new service and also include modifications to the B46 Local. For example, the B46 Local would run express between Eastern Parkway and Broadway for IPOs #2-#3 and #10-#13, and while this would result in a loss of local stops, it would also enable improved travel time and reliability for the local bus service by operating in the BRT transitway along this portion of the corridor.<sup>17</sup> In contrast, while IPOs #4-#9 would lack express bus service along the northern portion of the corridor (due to the replacement of the B46 SBS with the new subway service), the operational changes to the underlying bus service would result in reduced wait time for customers, as the B46 Local would offer increased frequency between Eastern Parkway and Broadway.

For these reasons, each of the 13 IPOs would serve EJ communities in the Study Area in different ways.<sup>18</sup> Similarly, all of the IPOs would serve EJ communities along the Nostrand Avenue Line and New Lots Avenue Line in different ways due to the different A-Division operating plans under consideration in the study and the corresponding split of TPH by line and terminal. The EJ communities along the Nostrand Avenue Line to Flatbush Av Terminal and along the New Lots Avenue Line to New Lots Av Terminal are shown on Figure 10 with respect to both minority and low-income populations. One of the key considerations in this study was the intent to define infrastructure and operational investments that could improve Utica Ave transit services without degrading other A-Division services in Brooklyn. As such, the following sections discuss the differences among the IPOs regarding key operational metrics (e.g., peak service delivery and OTP) not only for A-Division service to Utica Ave, but also along the Nostrand Avenue Line and New Lots Avenue Line.<sup>19</sup>

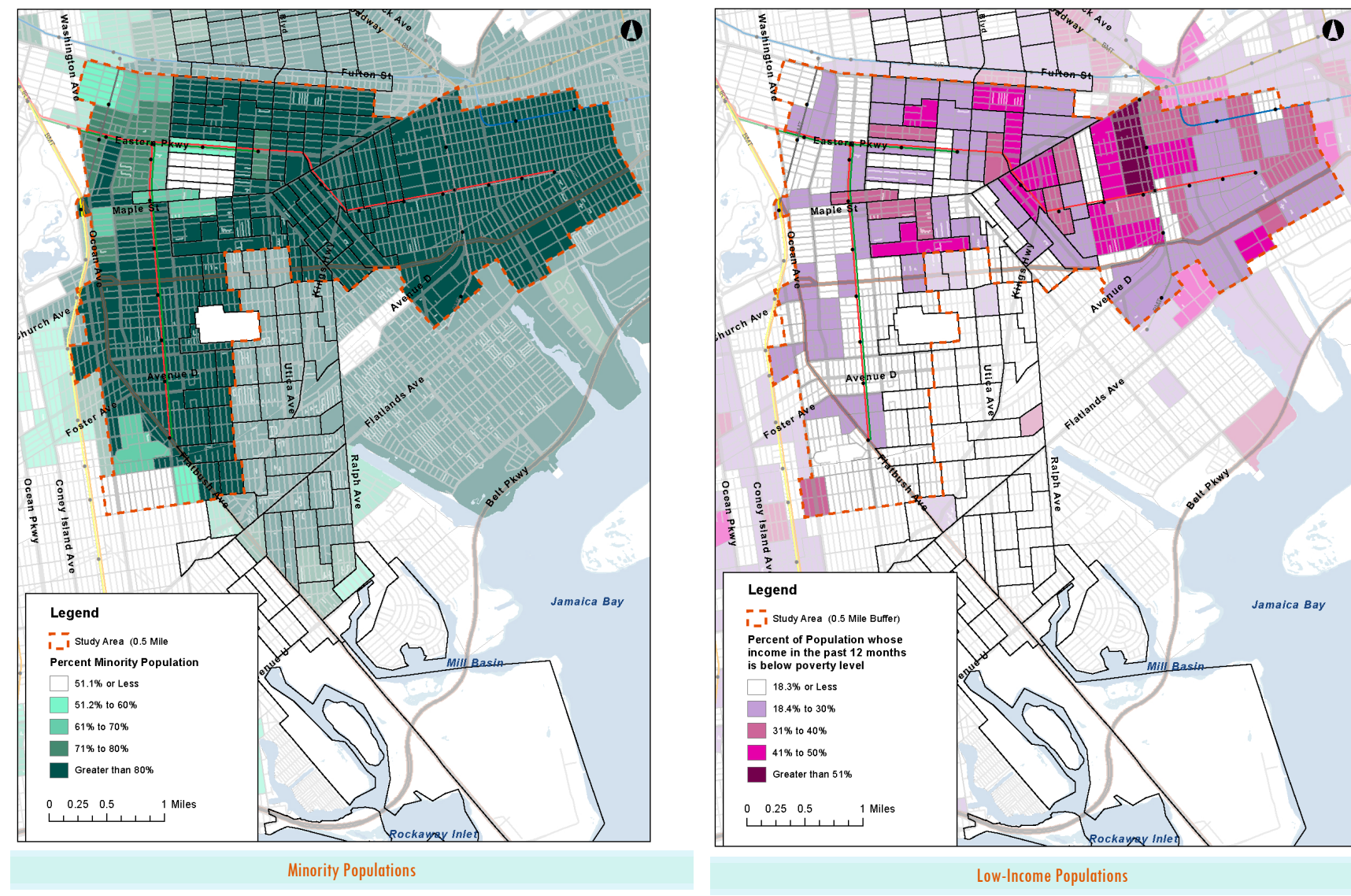
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<sup>17</sup> Refer to the Task 3 Appendices for a description of the alignment and operational characteristics of the IPOs.

<sup>18</sup> Although the nuanced distinction of how the IPOs would serve EJ communities was not enough of a differentiator to affect the recommendations for the Final Investment Packages, it was evaluated as a key consideration because—in conjunction with the ridership metric of linked trips on the project by low-income households (discussed in a subsequent section of this report—it reflected an important study objective to provide equitable transportation services.

<sup>19</sup> It is important to note that the Environmental Scan completed as part of the Utica Ave Study, which informed this discussion of EJ communities, was not a formal National Environmental Policy Act (NEPA), New York State Environmental Quality Review Act (SEQRA), or City Environmental Quality Review (CEQR) environmental review document. A formal environmental review would be necessary to ascertain the level of benefit and the likelihood and potential significance of any construction-related and/or long-term impacts due to the options under consideration for both the new transit service along Utica Ave as well as any associated A-Division improvements. As such, more analysis is needed beyond the scope of this study.

Figure 10: EJ Communities Along the Nostrand Avenue Line (to Flatbush Av Terminal) and New Lots Avenue Line (to New Lots Av Terminal)



Source: American Community Survey 2014-2018, Utica Ave Study



### Nostrand Junction Operations

One of the key considerations in the comparison of the 13 IPOs was whether the respective IPOs would address the Nostrand Junction chokepoint, which would also help to support long-term A-Division service growth in Brooklyn and across the network. The existing chokepoint at Nostrand Junction, which would remain in the No-Build Alternative, imposes a substantial constraint on A-Division operations. The source of the chokepoint is the short section of track (less than 200 feet) that is shared by the 2, 3, and 5 and accommodates the merging and diverging moves of the 2 and 5 to serve Flatbush Av Terminal (Figure 11). This short section of track caps the maximum frequency of these services, requires that their schedules be closely linked, and introduces additional delay when there are schedule deviations.

As shown on Figure 11, all of the even-numbered IPOs, which include the CBTC Baseline Operating Plan, would not eliminate the chokepoint at Nostrand Junction. The CBTC Baseline Operating Plan would maintain 2 and 5 service at Flatbush Av Terminal with a corresponding 20 TPH at this station and a maximum of 56 TPH for the overall Brooklyn A-Division. In contrast, all of the odd-numbered IPOs include the Modified Hybrid Operating Plan, which would eliminate the Nostrand Junction chokepoint and thereby enable service delivery of 24 TPH to Flatbush Av Terminal (with 2 and 3 service) and a total of 60 TPH for the overall Brooklyn A-Division.

The schematic graphics on Figure 11 show the differences in Nostrand Junction operations between the two operating plans, most notably the fact that the chokepoint due to merging and diverging conflicts would continue to exist with the CBTC Baseline Operating Plan under the even-numbered IPOs.

### New Service along, to, and from Utica Ave and Implications for Brooklyn A-Division Services

As introduced previously, the 13 IPOs included different assumptions for a new service along Utica Ave as well as the corresponding A-Division service to/from Utica Ave and for the overall Brooklyn A-Division. A number of operational metrics were evaluated to provide insight into the differences among the 13 IPOs, including changes in travel time, peak headways, and OTP, among others.

One of the key metrics for which the IPOs differed considerably was the extent of travel time savings from Kings Plaza to a number of representative destinations. The comparison of travel time savings among the IPOs was approached in three different geographic contexts: (1) travel within the Primary Study Area; (2) travel to the Secondary Study Area; and (3) travel beyond the Study Area.<sup>20</sup>

Table 3 shows the travel time savings for a transit trip from Kings Plaza to Eastern Parkway (i.e., within the Primary Study Area) and for transit trips from Kings Plaza to several representative destinations in the Secondary Study Area north of Eastern Parkway. For travel within the Primary Study Area, all IPOs—other than IPO #1, which would not introduce a new transit service along Utica Ave—would enable customers to realize travel time savings by replacing the B46 SBS with a faster service. Compared to the 30-minute travel time with the B46 SBS in the No-Build Alternative, the travel time savings for the IPOs would range from 7 minutes (23% savings) for the IPOs with BRT (i.e., IPOs #2-#3 and #10-#13) to 9-10 minutes (30-33% savings) for the IPOs with an A-Division Extension to Kings Plaza (i.e., IPOs #4-#7).<sup>21</sup>

For travel from Kings Plaza to destinations in the Secondary Study Area, the relative travel time savings among the IPOs varied depending upon the location of the destination. From Kings Plaza to Fulton Street, the IPOs with BRT (noted above) and those with the B-Division Shuttle (i.e., IPOs #8-#9) generated the greatest travel time savings of 11-12 minutes (31-33% savings compared to the No-Build). For all destinations north of Fulton Street in the Secondary Study Area, the IPOs with BRT demonstrated substantially greater travel time savings than the other IPOs, and the farther north the destination, the greater the travel time savings associated with BRT. The travel time savings to Myrtle Av (savings of 22 minutes or 42%) and to Woodhull Hospital (savings of 27 minutes or 46%) demonstrated one of the key benefits of BRT, as it would not only be a faster service compared to the B46 SBS but would also extend the route northward such that a transfer to the B46 Local would no longer be required to reach these destinations.

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<sup>20</sup> “Task 3 Appendix 3: Operational Inputs & Ridership Forecasts for the IPOs” provided insight into the relative number of customers that would benefit from the travel time savings from Kings Plaza. Specifically, Task 3 Appendix 3 included a summary of linked transit trips at the SuperZone level (corresponding to an aggregation of Transportation Analysis Zones [TAZ]), including a different tabulation for the No-Build Alternative and each IPO (using Land Use Scenario #2).

<sup>21</sup> The travel time calculations summarized in this report incorporated station access/egress, initial transfer and wait time, transfer walk time, and in-vehicle times.

Table 3: Transit Service Along Utica Ave — Travel Time Savings Within the Study Area for the 13 IPOs

			Travel Time		Travel Time Savings Compared to No-Build from Kings Plaza to Representative Destinations within the Primary and Secondary Study Areas													
			IPO #:		No-Build	IPO #1	IPO #2	IPO #3	IPO #4	IPO #5	IPO #6	IPO #7	IPO #8	IPO #9	IPO #10	IPO #11	IPO #12	IPO #13
			From Kings Plaza to:															
			New Utica Ave Transit Service:		N/A (B46 SBS)	N/A (B46 SBS)	BRT		A-Division Extension to Kings Plaza (Local Track)		A-Division Extension to Kings Plaza (Express Track)		B-Division Shuttle		BRT + A-Division Extension to Church Av (Local Track)		BRT + A-Division Extension to Church Av (Express Track)	
			A-Division Operating Plan:		CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid		
Primary Study Area	Utica Ave & Eastern Parkway		Min	30	0	7	7	9	10	10	10	8	8	7	7	7	7	
			%	0%	0%	23%	23%	30%	33%	33%	33%	27%	27%	23%	23%	23%	23%	
Secondary Study Area	Utica Ave & Fulton Street		Min	36	0	11	11	5	6	6	6	12	12	11	11	11	11	
			%	0%	0%	31%	31%	14%	17%	17%	17%	33%	33%	31%	31%	31%	31%	
	Malcolm X Blvd & Dekalb Avenue		Min	42	0	14	14	2	3	3	3	8	8	14	14	14	14	
			%	0%	0%	33%	33%	5%	7%	7%	7%	19%	19%	33%	33%	33%	33%	
	Broadway & Myrtle Avenue		Min	52	0	22	22	4	5	5	5	10	10	22	22	22	22	
			%	0%	0%	42%	42%	8%	10%	10%	10%	19%	19%	42%	42%	42%	42%	
	Woodhull Hospital		Min	59	0	27	27	4	5	5	5	10	10	27	27	27	27	
			%	0%	0%	46%	46%	7%	8%	8%	8%	17%	17%	46%	46%	46%	46%	

Source: Utica Ave Study

Note: Travel time calculation incorporates station access/egress, initial transfer and wait time, transfer walk time, and in-vehicle times.

Other than IPO #1, the IPOs with an A-Division Extension to Kings Plaza (#4-#7) resulted in the lowest travel time savings to all destinations in the Secondary Study Area—in contrast to travel within the Primary Study Area—because a transfer to the B46 Local would be required for any travel north of Eastern Parkway.

These same IPOs, however, resulted in the greatest travel time savings to representative destinations beyond the Study Area. As shown in Table 4, the IPOs with an A-Division Extension to Kings Plaza would generate 13-16 minutes in travel time savings to each of several destinations beyond the Study Area in Brooklyn and Manhattan. Depending upon the destination, this corresponded to approximately 21% to 35% savings compared to the No-Build Alternative. The savings would be due to a combination of faster travel from Kings Plaza to Eastern Parkway and the fact that a transfer would not be required at Eastern Parkway to access the subway (although the IPOs vary with respect to the provision of East Side or West Side IRT service to Kings Plaza, as discussed below).

In contrast, the IPOs with BRT would result in the lowest travel time savings (other than IPO #1) to the representative destinations beyond the Study Area, although customers would still realize travel time improvements (of at least approximately 10%) due to the new service along Utica Ave.

Overall, the extent of travel time savings—and the relative order of the IPOs with respect to travel time savings—differed depending on whether the representative transit trip was within the Primary Study Area, to the Secondary Study Area, or beyond the Study Area.

Table 4: Transit Service Along and To/From Utica Ave — Travel Time Savings Beyond the Study Area for the 13 IPOs

	Travel Time		Travel Time Savings Compared to No-Build from Kings Plaza to Representative Destinations Beyond the Study Area												
	IPO #:	No-Build	IPO #1	IPO #2	IPO #3	IPO #4	IPO #5	IPO #6	IPO #7	IPO #8	IPO #9	IPO #10	IPO #11	IPO #12	IPO #13
From Kings Plaza to:															
	New Utica Ave Transit Service:	N/A (B46 SBS)	N/A (B46 SBS)	BRT		A-Division Extension to Kings Plaza (Local Track)		A-Division Extension to Kings Plaza (Express Track)		B-Division Shuttle		BRT + A-Division Extension to Church Av (Local Track)		BRT + A-Division Extension to Church Av (Express Track)	
	A-Division Operating Plan:	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid
Atlantic Av — Barclays Center	Min	43	0	6	7	13	15	15	15	9	10	6	7	7	7
	%	0%	0%	14%	16%	30%	35%	35%	35%	21%	23%	14%	16%	16%	16%
Borough Hall	Min	47	0	6	7	13	15	15	15	9	10	6	7	7	7
	%	0%	0%	13%	15%	28%	32%	32%	32%	19%	21%	13%	15%	15%	15%
Fulton Street Transit Center	Min	53	1	7	7	13	15	16	16	9	10	7	7	8	8
	%	0%	2%	13%	13%	25%	28%	30%	30%	17%	19%	13%	13%	15%	15%
Penn Station	Min	68	0	6	7	13	15	15	15	9	9	6	7	7	7
	%	0%	0%	9%	10%	19%	22%	22%	22%	13%	13%	9%	10%	10%	10%
Grand Central Terminal	Min	62	0	6	7	13	15	15	15	9	10	6	7	7	7
	%	0%	0%	10%	11%	21%	24%	24%	24%	15%	16%	10%	11%	11%	11%

Source: Utica Ave Study

Note: Travel time calculation incorporates station access/egress, initial transfer and wait time, transfer walk time, and in-vehicle times.



Table 5 shows the service characteristics for the 13 IPOs—pertaining to service along and to/from Utica Ave—compared to the No-Build Alternative. With the exception of IPO #4, all IPOs would offer either the same or improved peak headways for the new service from Kings Plaza compared to the No-Build Alternative. IPO #4 would only offer 13 TPH, thereby resulting in an approximately 4.6-minute headway and corresponding longer scheduled wait times for customers compared to the B46 SBS in the No-Build Alternative.<sup>22</sup> IPO #1 would continue to offer B46 SBS service with 3-minute peak headways as in the No-Build Alternative, and IPOs #8 and #9 would also offer 3-minute peak headways, albeit with a B-Division Shuttle service to Fulton Street (with 20 TPH) instead of B46 SBS to Dekalb Av. The remaining IPOs would all offer increased service frequency from Kings Plaza compared to the No-Build Alternative. In offering 23 TPH, IPOs #5-#7 would provide customers with an approximately 2.6-minute peak headway, which would be an improvement over the 3-minute headways provided by the B46 SBS in the No-Build Alternative. All IPOs that include BRT (i.e., IPOs #2-#3 and #10-#13) would offer the greatest improvement in service frequency compared to the No-Build Alternative by providing 2-minute peak headways.

In addition to peak service frequency, Table 5 also shows end terminal OTP for the subway lines that terminate along Utica Ave based on the corresponding A-Division operating plan, although an important qualifier is that different IPOs have different A-Division terminal locations along Utica Ave (i.e., Crown Heights-Utica Av, Church Av, or Kings Plaza). Among those IPOs with increased service frequency to Kings Plaza compared to the No-Build Alternative, IPOs #5, #10, and #11 would also offer improved end terminal OTP for the subway lines that terminate along Utica Ave based on a 5-minute lateness threshold. IPO #5 would offer 98.7% end terminal OTP with a terminal location at Kings Plaza, and IPO #11 would offer the same end terminal OTP with a terminal location at Church Av. IPO #10 would offer 99.7% end terminal OTP for the subway lines that terminate at Church Av,<sup>23</sup> although it is important to keep in mind that this IPO would provide a total peak service of 56 TPH for the overall Brooklyn A-Division, whereas IPOs #5 and #11 would both provide 60 total TPH as enabled by the Modified Hybrid Operating Plan. Some of the other IPOs offer either the same end terminal OTP for the subway lines that terminate along Utica Ave as the No-Build Alternative (i.e., IPOs #2 and #8 at 96.5%) or slightly decreased end terminal OTP (i.e., IPOs #3 and #9 at 95.3%), whereas other IPOs result in a drop in end terminal OTP below 90% (i.e., IPOs #7 and #13 at 89.6% and IPOs #6 and #12 at 87.1%).

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<sup>22</sup> It should be noted that while the scheduled headway for IPO #4 would result in longer scheduled wait times compared to the No-Build Alternative, the capacity of the rolling stock is orders of magnitude greater for IPO #4 (i.e., A-Division trains) than the No-Build Alternative (i.e., articulated buses for the B46 SBS). The substantially greater capacity offered by IPO #4—even at longer headways—could potentially eliminate a scenario with the No-Build Alternative in which a customer is unable to board a bus that is at capacity and thus would have to wait another headway for the next bus.

<sup>23</sup> Similar to IPO #10, IPO #4 would also offer 99.7% end terminal OTP for the subway lines that terminate along Utica Ave (in this case, at Kings Plaza), but would result in a reduction in service frequency to Kings Plaza as discussed in the previous paragraph.

Table 5: Transit Service Along and To/From Utica Ave — Service Characteristics for the 13 IPOs

	Service Characteristics														
	IPO #:	No-Build	IPO #1	IPO #2	IPO #3	IPO #4	IPO #5	IPO #6	IPO #7	IPO #8	IPO #9	IPO #10	IPO #11	IPO #12	IPO #13
	New Utica Ave Transit Service:	N/A (B46 SBS)	N/A (B46 SBS)	BRT		A-Division Extension to Kings Plaza (Local Track)		A-Division Extension to Kings Plaza (Express Track)		B-Division Shuttle		BRT + A-Division Extension to Church Av (Local Track)		BRT + A-Division Extension to Church Av (Express Track)	
	A-Division Operating Plan:	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid
Peak Service Frequency / Headway for New Service Along Utica Ave		3 min (SBS)	3 min (SBS)	2 min	2 min	4.6 min	2.6 min	2.6 min	2.6 min	3 min	3 min	2 min	2 min	2 min	2 min
End Terminal OTP for Subway Lines that Terminate Along Utica Ave		96.5%	95.3%	96.5%	95.3%	99.7%	98.7%	87.1%	89.6%	96.5%	95.3%	99.7%	98.7%	87.1%	89.6%
A-Division Terminal Location Along Utica Ave		Crown Heights-Utica Av	Crown Heights-Utica Av	Crown Heights-Utica Av	Crown Heights-Utica Av	Kings Plaza	Kings Plaza	Kings Plaza	Kings Plaza	Crown Heights-Utica Av	Crown Heights-Utica Av	Church Av	Church Av	Church Av	Church Av

Source: Utica Ave Study

Notes:

- Peak headway is based on service at Kings Plaza station
- End Terminal OTP is based on 5-minute lateness threshold

In comparing the IPOs based on the A-Division service provided to/from Utica Ave—while also considering operational implications for other Brooklyn A-Division services—several key metrics were evaluated for Crown Heights-Utica Av Station, Flatbush Av Terminal, and New Lots Av Terminal. The first metric was the number of TPH that would serve each station.

As shown in Table 6, the number of TPH that would serve Crown Heights-Utica Av Station (i.e., all trains terminating along Utica Ave or at New Lots Av Terminal) was not a significant differentiator among the 13 IPOs. With the exception of IPOs #2 and #8, which would match the No-Build Alternative, all of the other IPOs would offer 36 TPH to this station, representing a slight improvement in service frequency from 1.9 minutes in the No-Build Alternative (i.e., 32 TPH) to 1.7 minutes for each IPO.

All IPOs would similarly offer either the same or increased frequency to both Flatbush Av Terminal and New Lots Av Terminal compared to the No-Build Alternative. All even-numbered IPOs would match the No-Build Alternative by offering 20 TPH to Flatbush Av Terminal, corresponding to 3-minute peak headways, whereas all odd-numbered IPOs would increase peak service delivery by offering 24 TPH (i.e., 2.5-minute peak headways). This increased service frequency to Flatbush Av Terminal associated with the odd-numbered IPOs would be enabled by the Modified Hybrid Operating Plan. With respect to peak service delivery to New Lots Av Terminal, most IPOs would offer 13 TPH (i.e., 4.6-minute peak headways), which would match the No-Build Alternative, and a few IPOs would offer increased service (i.e., IPOs #1, #3, and #9 with 16 TPH [3.8-minute headways] and IPOs #4 and #10 with 23 TPH [2.6-minute headways]).<sup>24</sup>

Another metric of interest was the extent to which the IPOs would result in changes in travel time for subway customers traveling north of Crown Heights-Utica Av Station or from Flatbush Av Terminal or New Lots Av Terminal. This metric was evaluated by comparing weighted average (local/express) travel time from each of these three stations to Nevins Street, which corresponded to the northern limits of the rail simulation model for the West Side IRT, and also offered insight into travel time through Nostrand Junction. Based on the outputs from the rail simulation model, all IPOs—except IPOs #2 and #8, whose A-Division operating characteristics matched the No-Build Alternative—would improve travel time from Crown Heights-Utica Av Station, with IPOs #7 and #13 offering the greatest travel time savings at 56 seconds, and IPOs #1, #3, and #9 offering comparable savings of 44 seconds (Table 7).<sup>25</sup> Additionally, all IPOs other than IPOs #2 and #8 would improve travel time from New Lots Av Terminal—with IPOs #4, #5, #10, and #11 offering the greatest travel time savings, each in excess of four minutes (due to the provision of express service)—and would result in a modest increase in travel time (of less than one minute) from Flatbush Av Terminal.

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<sup>24</sup> It is important to note that for each IPO, the service frequencies at the A-Division southern termini were the result of total TPH scheduled for each line and the service design in Brooklyn, and were not necessarily representative of demand along the respective branches.

<sup>25</sup> “Task 3 Appendix 3: Operational Inputs & Ridership Forecasts for the IPOs” provided insight into the relative number of customers that would experience the travel time changes to Nevins Street. Specifically, Task 3 Appendix 3 included a summary of subway screenline data for Crown Heights-Utica Av Station, Flatbush Av Terminal, and New Lots Av Terminal for each of the IPOs.

Table 6: Peak TPH and Service Frequency for the 13 IPOs

Peak TPH Serving Each Station (Frequency/Headway)															
Station	IPO #:	No-Build	IPO #1	IPO #2	IPO #3	IPO #4	IPO #5	IPO #6	IPO #7	IPO #8	IPO #9	IPO #10	IPO #11	IPO #12	IPO #13
	New Utica Ave Transit Service:	N/A (B46 SBS)	N/A (B46 SBS)	BRT		A-Division Extension to Kings Plaza (Local Track)		A-Division Extension to Kings Plaza (Express Track)		B-Division Shuttle		BRT + A-Division Extension to Church Av (Local Track)		BRT + A-Division Extension to Church Av (Express Track)	
	A-Division Operating Plan:	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid
Crown Heights-Utica Av Station		32 TPH (1.9 min)	36 TPH (1.7 min)	32 TPH (1.9 min)	36 TPH (1.7 min)	36 TPH (1.7 min)	36 TPH (1.7 min)	36 TPH (1.7 min)	36 TPH (1.7 min)	32 TPH (1.9 min)	36 TPH (1.7 min)	36 TPH (1.7 min)	36 TPH (1.7 min)	36 TPH (1.7 min)	36 TPH (1.7 min)
Flatbush Av Terminal		20 TPH (3 min)	24 TPH (2.5 min)	20 TPH (3 min)	24 TPH (2.5 min)	20 TPH (3 min)	24 TPH (2.5 min)	20 TPH (3 min)	24 TPH (2.5 min)	20 TPH (3 min)	24 TPH (2.5 min)	20 TPH (3 min)	24 TPH (2.5 min)	20 TPH (3 min)	24 TPH (2.5 min)
New Lots Av Terminal		13 TPH (4.6 min)	16 TPH (3.8 min)	13 TPH (4.6 min)	16 TPH (3.8 min)	23 TPH (2.6 min)	13 TPH (4.6 min)	13 TPH (4.6 min)	13 TPH (4.6 min)	13 TPH (4.6 min)	16 TPH (3.8 min)	23 TPH (2.6 min)	13 TPH (4.6 min)	13 TPH (4.6 min)	13 TPH (4.6 min)

Source: Utica Ave Study  
Note: The number of TPH that serves Crown Heights-Utica corresponds to all trains terminating along Utica Ave (whether at Kings Plaza, Church Av, or Crown Heights-Utica Av Station) or at New Lots Av Terminal

Table 7: Weighted Average Travel Time to Nevins Street for the 13 IPOs

To Nevins Street from:		Weighted Average Travel Time to Nevins Street for Local/Express Trains (minutes:seconds)														
		IPO #:	No-Build	IPO #1	IPO #2	IPO #3	IPO #4	IPO #5	IPO #6	IPO #7	IPO #8	IPO #9	IPO #10	IPO #11	IPO #12	IPO #13
		New Utica Ave Transit Service:	N/A (B46 SBS)	N/A (B46 SBS)	BRT		A-Division Extension to Kings Plaza (Local Track)		A-Division Extension to Kings Plaza (Express Track)		B-Division Shuttle		BRT + A-Division Extension to Church Av (Local Track)		BRT + A-Division Extension to Church Av (Express Track)	
		A-Division Operating Plan:	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid
Crown Heights- Utica Av Station	Travel Time	09:19	08:35	09:19	08:35	08:54	08:55	09:04	08:23	09:19	08:35	08:54	08:55	09:04	08:23	
	Difference Compared to No-Build (%)	N/A	-00:44 (-8%)	0 (0%)	-00:44 (-8%)	-00:25 (-4%)	-00:24 (-4%)	-00:15 (-3%)	-00:56 (-10%)	0 (0%)	-00:44 (-8%)	-00:25 (-4%)	-00:24 (-4%)	-00:15 (-3%)	-00:56 (-10%)	
Flatbush Av Terminal	Travel Time	17:27	18:08	17:27	18:08	17:36	17:54	17:35	18:03	17:27	18:08	17:36	17:54	17:35	18:03	
	Difference Compared to No-Build (%)	N/A	+00:41 (4%)	0 (0%)	+00:41 (4%)	+00:09 (1%)	+00:27 (3%)	+00:08 (1%)	+00:36 (3%)	0 (0%)	+00:41 (4%)	+00:09 (1%)	+00:27 (3%)	+00:08 (1%)	+00:36 (3%)	
New Lots Av Terminal	Travel Time	22:22	19:56	22:22	19:56	18:10	18:20	22:09	19:54	22:22	19:56	18:10	18:20	22:09	19:54	
	Difference Compared to No-Build (%)	N/A	-02:26 (-11%)	0 (0%)	-02:26 (-11%)	-04:12 (-19%)	-04:02 (-18%)	-00:13 (-1%)	-02:28 (-11%)	0 (0%)	-02:26 (-11%)	-04:12 (-19%)	-04:02 (-18%)	-00:13 (-1%)	-02:28 (-11%)	

Source: Utica Ave Study

Note: Travel time corresponds to a weighted average of local and express service as applicable. Travel time is local only from New Lots Av Terminal for the No-Build and IPOs #2 and #8.

In addition to comparing end terminal OTP for the subway lines that would terminate along Utica Ave (discussed previously), it was also important to evaluate the end terminal OTP to Flatbush Av Terminal, New Lots Av Terminal, and for the overall Brooklyn A-Division to establish a holistic understanding of the implications of the 13 IPOs for Brooklyn A-Division services. As the point of comparison for the IPOs, the No-Build Alternative—also reflected in IPOs #2 and #8 from the perspective of A-Division operations—performed very well for the metric of end terminal OTP based on a 5-minute lateness threshold to Flatbush Av Terminal (98.5%), New Lots Av Terminal (99.0%), and for the overall Brooklyn A-Division (97.9%). As shown in Table 8, all IPOs other than IPOs #2 and #8 would build upon the reliability of the No-Build Alternative by improving end terminal OTP for Flatbush Av Terminal. Most of the IPOs showed minimal change in end terminal OTP to New Lots Av Terminal of less than  $\pm 1\%$  difference compared to the No-Build Alternative. Even those IPOs that experienced the largest drop in end terminal OTP for New Lots Av Terminal (i.e., IPOs #1, #3, and #9 with a drop in 2%) would still have an OTP of 97%.

When evaluating end terminal OTP for the overall Brooklyn A-Division, the range among the IPOs varied from 94.8% on the low end (i.e., for IPOs #6 and #12) to 99.8% on the high end (i.e., for IPOs #4 and #10). With an approximately 97.7% end terminal OTP for the overall Brooklyn A-Division, IPOs #1, #3, and #9 showed a negligible change compared to the No-Build, although these IPOs—and all odd-numbered IPOs—included an additional 4 TPH for the overall Brooklyn A-Division (i.e., 60 TPH compared to 56 TPH) as enabled by the Modified Hybrid Operating Plan. Among those IPOs with 60 total TPH, IPOs #5 and #11 would offer the highest end terminal OTP for the overall Brooklyn A-Division at 99.3%.

The IPOs also differed with respect to one-seat ride connectivity to the East and West Sides of Manhattan from Kings Plaza, Flatbush Av Terminal, and New Lots Av Terminal (Table 9). IPOs #4-#7 would all provide a one-seat ride from Kings Plaza to either the East Side or West Side of Manhattan by extending A-Division service south along Utica Ave to Kings Plaza. Of note, IPO #5 is the only IPO that would provide a one-seat ride from Kings Plaza to both the East Side and West Side of Manhattan. All even-numbered IPOs (i.e., all IPOs with the CBTC Baseline Operating Plan) would continue to provide a one-seat ride from Flatbush Av Terminal to both the East Side and West Side of Manhattan, whereas the odd-numbered IPOs (i.e., all IPOs with the Modified Hybrid Operating Plan) would not. Other service changes compared to the No-Build Alternative include the fact that IPOs #4, #5, #10, and #11 would provide a one-seat ride from New Lots Av Terminal to the East Side of Manhattan (with express service in Brooklyn) instead of to the West Side of Manhattan (with local service in Brooklyn). Additionally, IPOs #1, #3, #7, #9, and #13 would provide a one-seat ride from New Lots Av Terminal to both the East Side and West Side of Manhattan.



Table 8: End Terminal OTP Based on 5-minute Lateness Threshold for the 13 IPOs

		End Terminal OTP based on 5-Minute Lateness Threshold														
		IPO #:	No-Build	IPO #1	IPO #2	IPO #3	IPO #4	IPO #5	IPO #6	IPO #7	IPO #8	IPO #9	IPO #10	IPO #11	IPO #12	IPO #13
		New Utica Ave Transit Service:	N/A (B46 SBS)	N/A (B46 SBS)	BRT		A-Division Extension to Kings Plaza (Local Track)		A-Division Extension to Kings Plaza (Express Track)		B-Division Shuttle		BRT + A-Division Extension to Church Av (Local Track)		BRT + A-Division Extension to Church Av (Express Track)	
		A-Division Operating Plan:	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid
Flatbush Av Terminal	End Terminal OTP	98.5%	99.8%	98.5%	99.8%	100.0%	99.7%	99.2%	100.0%	98.5%	99.8%	100.0%	99.7%	99.2%	100.0%	
	Difference from No-Build	N/A	1.4%	0.0%	1.4%	1.5%	1.2%	0.7%	1.5%	0.0%	1.4%	1.5%	1.2%	0.7%	1.5%	
New Lots Av Terminal	End Terminal OTP	99.0%	97.0%	99.0%	97.0%	99.6%	99.5%	99.4%	98.6%	99.0%	97.0%	99.6%	99.5%	99.4%	98.6%	
	Difference from No-Build	N/A	-2.0%	0.0%	-2.0%	0.6%	0.5%	0.4%	-0.4%	0.0%	-2.0%	0.6%	0.5%	0.4%	-0.4%	
Overall Brooklyn A-Division	End Terminal OTP	97.9%	97.7%	97.9%	97.7%	99.8%	99.3%	94.8%	96.4%	97.9%	97.7%	99.8%	99.3%	94.8%	96.4%	
	Difference from No-Build	N/A	-0.2%	0.0%	-0.2%	1.9%	1.4%	-3.1%	-1.5%	0.0%	-0.2%	1.9%	1.4%	-3.1%	-1.5%	

Source: Utica Ave Study

Table 9: One-Seat Ride Connectivity for the 13 IPOs

	One-Seat Ride Connectivity														
	IPO #:	No-Build	IPO #1	IPO #2	IPO #3	IPO #4	IPO #5	IPO #6	IPO #7	IPO #8	IPO #9	IPO #10	IPO #11	IPO #12	IPO #13
	New Utica Ave Transit Service:	N/A (B46 SBS)	N/A (B46 SBS)	BRT		A-Division Extension to Kings Plaza (Local Track)		A-Division Extension to Kings Plaza (Express Track)		B-Division Shuttle		BRT + A-Division Extension to Church Av (Local Track)		BRT + A-Division Extension to Church Av (Express Track)	
	A-Division Operating Plan:	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid	CBTC Baseline	Modified Hybrid
Kings Plaza to East Side of Manhattan		No	No	No	No	No	Yes	Yes	Yes	No	No	No	No	No	No
Kings Plaza to West Side of Manhattan		No	No	No	No	Yes	Yes	No	No	No	No	No	No	No	No
Flatbush Av to East Side of Manhattan		Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Flatbush Av to West Side of Manhattan		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
New Lots Av to East Side of Manhattan		No	Yes	No	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	No	Yes
New Lots Av to West Side of Manhattan		Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes

Source: Utica Ave Study

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### Ridership Forecasts, Cost Estimates, and Cost Effectiveness

The operational assumptions for the IPOs served as inputs to the ridership model.<sup>26</sup> The key ridership metrics of new riders, total linked trips on the project, and linked trips on the project by low-income households are presented in Table 10 for the 13 IPOs based on Land Use Scenario #2.<sup>27</sup>

As shown in Table 10, the three IPOs that generated the highest numbers of new riders (i.e., IPOs #3, #11, and #13) all included BRT along Utica Ave with the Modified Hybrid Operating Plan on the A-Division, and two of the three also included an A-Division Extension to Church Av. All IPOs that included both BRT and an A-Division Extension to Church Av (i.e., IPOs #10-#13) generated relatively high numbers of new riders [REDACTED] and the B-Division Shuttle (i.e., IPO #8) stood out for the significantly lower number of new riders compared to all other IPOs. Of note, there was a stark difference in the number of new riders associated with IPOs #8 and #9 [REDACTED] in addition to IPOs #2 and #3 [REDACTED].<sup>28</sup> IPOs #8 and #9 both included the same service along Utica Ave—as did IPOs #2 and #3, albeit BRT instead of B-Division Shuttle—but differed with respect to the A-Division operating plan. In this comparison, the IPOs with the Modified Hybrid Operating Plan on the A-Division generated substantially more new riders than the IPOs with the CBTC Baseline Operating Plan, thereby demonstrating the ridership benefits associated with the A-Division improvements that would enable the Modified Hybrid Operating Plan. This was further exhibited by the number of new riders that could be generated by IPO #1, which included the Modified Hybrid Operating Plan on the A-Division without any new transit service on Utica Ave.

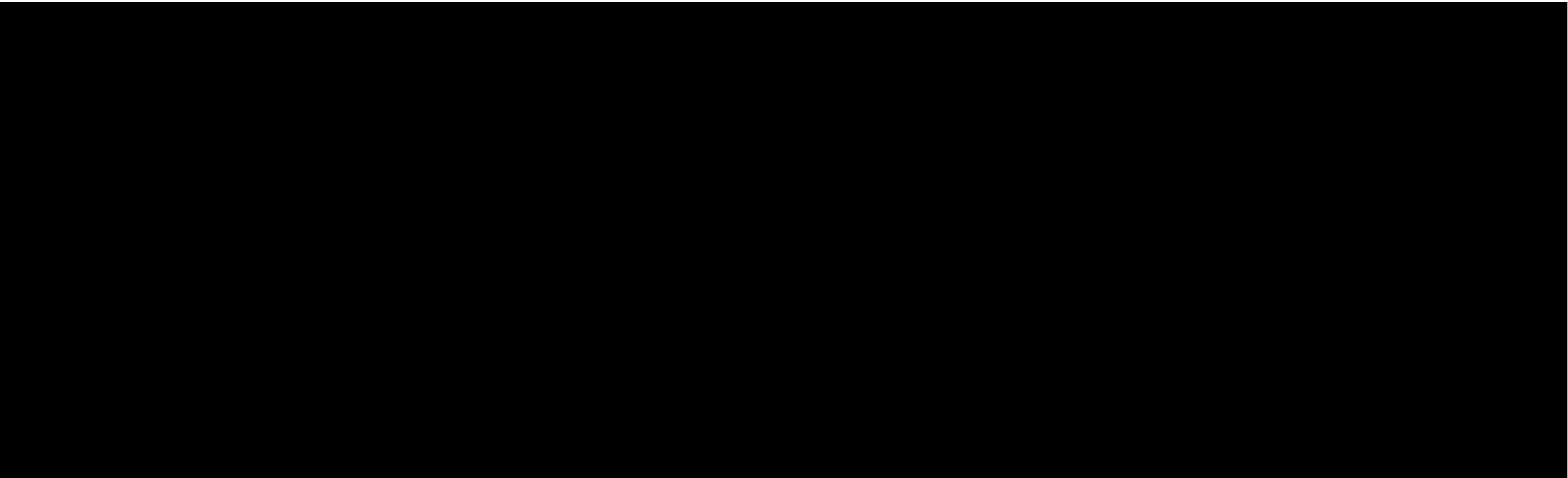
Table 10 also shows that while the IPOs with an A-Division Extension to Kings Plaza (i.e., IPOs #4-#7) generated a relatively modest number of new riders [REDACTED] compared to the other IPOs, these IPOs reported comparatively high numbers of total linked trips on the project [REDACTED]. Similarly, the IPOs with an A-Division Extension to Church Av paired with BRT (i.e., IPOs #10-#13) all had [REDACTED] daily linked trips on the project. The IPOs without an A-Division Extension reported lower numbers of total links trips on the project, which underscored the attractiveness of the A-Division Extension options. While the IPOs with an A-Division Extension generated the most overall linked trips on the project, the IPOs with BRT reported the most linked trips on the project by low-income households. This reflected the fact that the BRT would serve the northern portion of the Study Area that includes concentrations of low-income populations, as noted previously in the context of serving EJ communities.

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<sup>26</sup> Refer to “Task 3 Appendix 3: Operational Inputs & Ridership Forecasts for the IPOs” for additional information.

<sup>27</sup> Land Use Scenario #2 corresponded to the scenario with a moderate increase in population and employment when compared to Land Use Scenarios #1 and #3. Refer to Appendix 2 for additional details about the three Land Use Scenarios.

<sup>28</sup> The reason for this stark difference is that the service provided by the Modified Hybrid Operating Plan for IPOs #9 and #3 (i.e., the same as IPO #1) would benefit customers on the entire Brooklyn A-Division, thereby generating many new riders beyond the Utica Ave corridor (e.g., along the subway lines serving Flatbush Av Terminal and New Lots Av Terminal, in addition to Crown Heights-Utica Av Station). In contrast, the CBTC Baseline Operating Plan for IPOs #8 and #2 would provide the same A-Division service as the No-Build Alternative.



Source: Utica Ave Study  
Note: Ridership forecasts based on Land Use Scenario #2

Table 11 presents order-of-magnitude estimates of capital cost and incremental annual operating and maintenance (O&M) cost for the 13 IPOs in 2020 dollars.<sup>29</sup> The IPOs with a Utica Ave subway line to Kings Plaza (i.e., IPOs #4-#9)—and specifically the fully underground alignment concepts for these IPOs—would have the highest order-of-magnitude capital cost among the 13 IPOs, ranging from approximately [REDACTED] on the low end for one of the A-Division Extension options to approximately [REDACTED] on the high end for one of the B-Division Shuttle options. The next highest tier of capital costs was associated with the aerial alignment concepts for the same grouping of IPOs (i.e., those with a Utica Ave subway line to Kings Plaza), ranging from approximately [REDACTED]. The third and fourth highest tiers of capital costs included the underground and aerial alignment options, respectively, for the IPOs with a partial A-Division Extension to Church Av paired with BRT (i.e., IPOs #10-#13). These IPOs would have a corresponding capital cost ranging from approximately [REDACTED] for the underground alignment options and [REDACTED] for the aerial alignment options.<sup>30</sup>

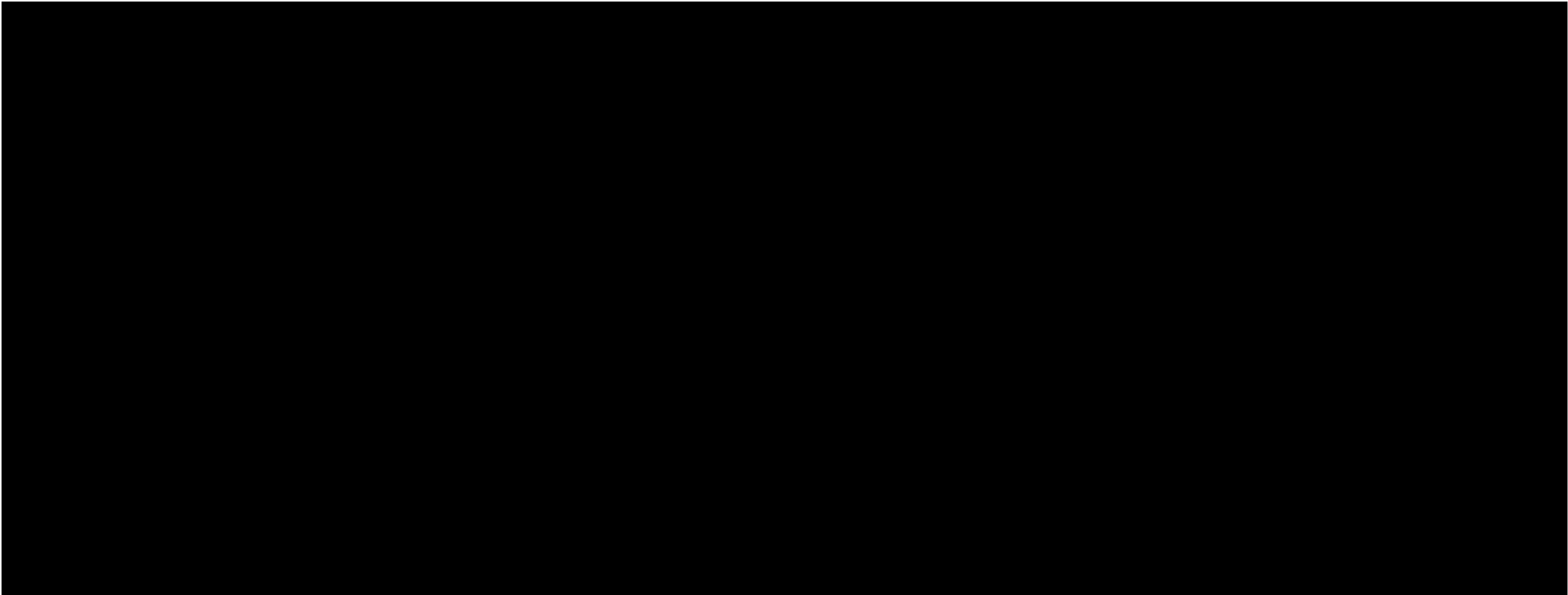
The remaining IPOs (i.e., IPOs #1-#3) all had a capital cost of less than [REDACTED] although there was a substantial range among these three IPOs. At an estimated capital cost of approximately [REDACTED] IPO #2 had the lowest capital cost and corresponded to the capital investment to implement the BRT service. IPO #1 had the second lowest overall capital cost and the lowest capital cost excluding vehicle acquisition among the 13 IPOs. From an infrastructure investment standpoint, IPO #1 only included A-Division improvements (at an estimated cost of [REDACTED] and no new service along Utica Ave, but the vehicle acquisition to provide the additional A-Division service associated with the Modified Hybrid Operating Plan would cost approximately [REDACTED] and thus the overall capital cost for IPO #1 was approximately [REDACTED]. Moreover, since IPO #3 corresponded to the pairing of BRT (i.e., IPO #2) with A-Division improvements and the Modified Hybrid Operating Plan (i.e., IPO #1), the capital cost for IPO #3 was the sum of the respective capital costs for IPO #2 [REDACTED] and IPO #1 [REDACTED].

As shown in Table 11, all of the odd-numbered IPOs had substantially higher incremental annual O&M costs than the even-numbered IPOs, which was due to the more robust A-Division service enabled by the Modified Hybrid Operating Plan. As previously noted, all of the IPOs with the Modified Hybrid Operating Plan would include a total of 60 TPH throughout the Brooklyn A-Division, whereas those with the CBTC Baseline Operating Plan would include 56 TPH. As such, the additional A-Division service offered through the Modified Hybrid Operating Plan was reflected in higher incremental annual O&M costs, ranging from approximately [REDACTED] for IPO #1) to [REDACTED] for IPO #9) depending on the other service provided by the respective IPO. The IPO with the lowest incremental annual O&M cost was IPO #2 (at a cost of approximately [REDACTED] which not only included the CBTC Baseline Operating Plan (and thus relatively lower A-Division O&M costs) but also the lower-cost BRT service instead of a Utica Ave subway line.

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<sup>29</sup> The O&M cost estimates are presented as incremental annual costs for the purpose of comparison to the No-Build Alternative. Refer to “Task 3 Appendix 5: Order-of-Magnitude Capital Cost & Construction Duration Estimates for the IPOs” and “Task 3 Appendix 6: Order-of-Magnitude Operating & Maintenance (O&M) Cost Estimates for the IPOs” for information regarding the methodology and additional details about the capital and O&M cost estimates, respectively.

<sup>30</sup> It is important to note that capital cost alone is not a fair evaluation criterion to compare different modal options for a new transit service, as certain modes (e.g., subway) are inherently more capital intensive than other modes (e.g., BRT). When evaluating different options across modes, it is more appropriate to use capital cost with other metrics, such as the capital cost per new rider, as discussed in this report as a measure of cost effectiveness across all 13 IPOs.



- Notes:
- The capital cost estimates conservatively assume a design-bid-build contracting method. The potential efficiencies that could be realized through a design-build contracting method are discussed in “Task 3 Appendix 5: Order-of-Magnitude Capital Cost & Construction Duration Estimates for the IPOs.”
  - The range in capital cost estimates for certain IPOs reflects different alignment options, discussed in Task 3 Appendix 5.
  - Vehicle acquisition for IPOs with BRT assumes that the electric articulated buses that would be used for the B46 SBS in the No-Build condition would be re-purposed for the BRT service.
  - Ridership forecasts based on Land Use Scenario #2.



As a measure of cost effectiveness, Table 11 also shows the comparison of estimated capital and O&M costs to the number of new riders resulting from implementation of each IPO.<sup>31</sup> IPOs #1-#3 would be the most cost-effective based on capital cost, as all three IPOs would have a [REDACTED] total capital cost per annual new rider trip. The relative cost effectiveness of IPOs #1-#3 was indicative of both a comparatively low capital cost for each IPO and a moderate number of new riders generated by each IPO. In contrast, the least cost-effective IPO was IPO #8, which reflected a combination of a high capital cost and low number of new riders. Among the IPOs that included a Utica Ave subway line, the most cost-effective based on capital cost were the aerial alignment options for the IPOs that paired BRT with an A-Division Extension to Church Av (i.e., IPOs #10-#13), with a corresponding capital cost per annual new rider trip ranging from approximately [REDACTED] [REDACTED]<sup>2</sup>

Using a comparable metric associated with O&M cost, IPO #2 would be the most cost-effective of the 13 IPOs. Similar to the assessment based on capital cost, the cost effectiveness of IPO #2 was due to the relatively low O&M cost (as discussed above) and a moderate number of new riders generated by the project. An analogous comparison was also possible with IPO #8, which was the least cost-effective as a result of the moderate O&M cost and a very low number of new riders generated by the project. The incremental O&M cost per annual new rider trip for all IPOs ranged from approximately [REDACTED] for IPOs #2, #10, and #12) to [REDACTED] for IPO #8).<sup>33</sup>

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<sup>31</sup> During a Utica Ave Study Steering Committee meeting, it was noted that benefits to existing riders are important considerations in addition to understanding the costs per new rider. The metrics described earlier in this report (e.g., travel time, service frequency, OTP, etc.) would be applicable to existing riders as well as new riders, thereby underscoring the range of criteria that informed the comparison of the IPOs.

<sup>32</sup> For each IPO with a Utica Ave subway line (i.e., IPOs #4-#13), separate cost effectiveness metrics are presented in Table 11 for underground and aerial alignment concepts. For a given IPO, the ridership potential for an alignment that transitions to an aerial guideway would be comparable to an alignment that remains fully underground, as the time to ramp up to an aerial guideway and any differences in station access/egress times would be insignificant in the context of the ridership forecasts. However, some (but not all) aerial alignment concepts would not be able to accommodate a station between Eastern Parkway and Church Av, which was accounted for in the capital cost estimates and could be revisited in a subsequent design phase in conjunction with alignment-specific ridership forecasts.

<sup>33</sup> Another measure of cost effectiveness is the comparison of estimated costs to the total number of linked trips on the project. This is particularly informative with respect to O&M costs, as it provides insight into the relative cost to operate the new service for each customer as opposed to just new riders. Among the 13 IPOs, the incremental annual O&M cost per linked trip on the project ranged from approximately [REDACTED] for IPO #2) to [REDACTED] (for IPO #9).

## Summary

The above comparison of the 13 IPOs demonstrated that while several differentiators emerged, no individual IPO performed the best across all metrics. Key takeaways from the targeted comparison of the 13 IPOs included the following:

- All 13 IPOs would serve EJ communities,<sup>34</sup> albeit in different ways depending on the operational characteristics of the new service along Utica Ave and the corresponding A-Division operating plan, in addition to changes in underlying B46 Local bus service.
- All odd-numbered IPOs would eliminate the Nostrand Junction chokepoint and realize the operational benefits by implementing the Modified Hybrid Operating Plan, whereas the even-numbered IPOs would not do so by implementing the CBTC Baseline Operating Plan.
- IPOs with the A-Division Extension to Kings Plaza (i.e., IPOs #4-#7) would offer the greatest travel time savings for travel from Kings Plaza to Eastern Parkway (i.e., travel within the Primary Study Area) and to a set of representative destinations beyond the Study Area in Brooklyn and Manhattan. For travel from Kings Plaza to the Secondary Study Area, the IPOs with BRT (i.e., IPOs #2-#3 and #10-#13) demonstrated the greatest travel time savings, and the farther north the destination, the greater the savings associated with BRT.
- With the exception of IPO #4, all IPOs would offer either the same or improved peak headways for the new service along Utica Ave (from Kings Plaza) compared to the No-Build Alternative. Among those IPOs with increased service frequency compared to the No-Build Alternative, IPOs #5, #10, and #11 would also offer improved end terminal OTP for the subway lines that terminate along Utica Ave based on a 5-minute lateness threshold, and IPOs #5 and #11 would both provide 60 total TPH for the overall Brooklyn A-Division (whereas IPO #10 would provide 56 TPH).
- All 13 IPOs would offer either the same or increased frequency to Crown Heights-Utica Av Station, Flatbush Av Terminal, and New Lots Av Terminal compared to the No-Build Alternative. With the exception of IPOs #2 and #8, whose A-Division operating characteristics matched the No-Build Alternative, all IPOs would:
  - Improve travel time from Crown Heights-Utica Av Station to Nevins Street, with IPOs #7 and #13 offering the greatest travel time savings of nearly one minute, and IPOs #1, #3, and #9 also offering savings of nearly 45 seconds;
  - Improve travel time from New Lots Av Terminal to Nevins Street and result in a modest increase in travel time (of less than one minute) from Flatbush Av Terminal; and

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<sup>34</sup> However, as noted previously, more analysis is needed beyond the scope of this study to ascertain the level of benefit and the likelihood and potential significance of any construction-related and/or long-term impacts due to the options under consideration for both the new transit service along Utica Ave as well as any associated A-Division improvements.

- Build upon the reliability of the No-Build Alternative by improving end terminal OTP for Flatbush Av Terminal and generally maintaining end terminal OTP for New Lots Av Terminal (all at or above 97%).
- With an approximately 97.7% end terminal OTP for the overall Brooklyn A-Division, IPOs #1, #3, and #9 showed a negligible change compared to the No-Build, although these IPOs—and all odd-numbered IPOs—included an additional 4 TPH for the overall Brooklyn A-Division (i.e., 60 TPH compared to 56 TPH) as enabled by the Modified Hybrid Operating Plan. Among those IPOs with a total of 60 TPH, IPOs #5 and #11 would offer the highest end terminal OTP for the overall Brooklyn A-Division at 99.3%.
- The IPOs differed with respect to one-seat ride connectivity to the East and West Sides of Manhattan. IPO #5 is the only IPO that would provide a one-seat ride from Kings Plaza to both the East Side and West Side of Manhattan. All even-numbered IPOs (i.e., all IPOs with the CBTC Baseline Operating Plan) would continue to provide a one-seat ride from Flatbush Av Terminal to both the East Side and West Side of Manhattan, whereas the odd-numbered IPOs (i.e., all IPOs with the Modified Hybrid Operating Plan) would not.
- The three IPOs that generated the highest numbers of new riders (i.e., IPOs #3, #11, and #13) all included BRT along Utica Ave with the Modified Hybrid Operating Plan on the A-Division, and two of the three also included an A-Division Extension to Church Av. This was indicative of the ridership benefits associated with both the BRT service as well as the Modified Hybrid Operating Plan.
- The IPOs with an A-Division Extension generated the most overall linked trips on the project, and the IPOs with BRT reported the most linked trips on the project by low-income households, which was a reflection of the concentration of low-income populations in the northern portion of the Study Area that could be served by BRT.
- The IPOs with a Utica Ave subway line to Kings Plaza (i.e., IPOs #4-#9)—and specifically the fully underground alignment concepts for these IPOs—had the highest order-of-magnitude capital cost among the 13 IPOs. IPOs #1-#3 had the lowest estimated capital cost and demonstrated the greatest cost effectiveness relative to the number of new riders generated by each IPO. All odd-numbered IPOs would have substantially higher incremental annual O&M costs than the even-numbered IPOs due to the additional A-Division service associated with the Modified Hybrid Operating Plan.

Based on this summary and the preceding discussion, different IPOs offered different benefits, and no individual IPO stood out as the best option. As such, the targeted comparison of the IPOs supported the outcome of this study as a set of Final Investment Packages—each with different advantages—as opposed to a single locally preferred alternative.

## 6.4 SELECTION OF FINAL INVESTMENT PACKAGES

As introduced in a previous section of this report, the selection of the Final Investment Packages was informed by the targeted comparison of all 13 IPOs, the ranking of IPOs #4-#7 in Task 4, and the intent to offer a range of investment levels and service concepts for the Utica Ave transit improvements that would best achieve the study goals and objectives.

A fundamental differentiator among the IPOs under consideration was that the odd-numbered IPOs (i.e., those with the Modified Hybrid Operating Plan) would eliminate the Nostrand Junction chokepoint, whereas the even-numbered IPOs (i.e., those with the CBTC Baseline Operating Plan) would not. Among those IPOs that would eliminate the Nostrand Junction chokepoint, IPO #1 would require the lowest capital investment by hundreds of millions of dollars. This IPO would include A-Division improvements and the Modified Hybrid Operating Plan to supplement the B46 SBS, and the service along Utica Ave would remain unchanged from the No-Build Alternative. As such, IPO #1 would realize the operational and ridership benefits of the Modified Hybrid Operating Plan without introducing a new service along Utica Ave. In this way, IPO #1 would offer a cost-effective opportunity to address the Nostrand Junction chokepoint and improve service to/from Utica Ave in conjunction with enabling an increase in peak service delivery on the Brooklyn A-Division. For these reasons, IPO #1 was selected as one of the Final Investment Packages.

The advantages of the Modified Hybrid Operating Plan were further demonstrated by comparing IPOs #2 and #3. Both of these IPOs would introduce BRT along Utica Ave, corresponding to a relatively cost-effective transit solution (compared to the more capital-intensive IPOs that would introduce a subway line along Utica Ave) to address conditions that degrade the B46 SBS, with additional benefits due to travel time savings and connectivity to the Broadway Line and Woodhull Hospital. However, IPO #2 would not address the Nostrand Junction chokepoint, which was reflected in a lower number of TPH on the overall Brooklyn A-Division as well as the estimated number of new riders generated by the IPO. Of note, the total number of new riders associated with IPO #3 [REDACTED] was projected to be greater than the sum of the new riders associated with IPOs #1 and #2 [REDACTED] thereby underscoring the opportunity to achieve synergies with complementary improvements on- and off-corridor. Among the 13 IPOs, IPO #3 was also the one with the lowest capital cost that would both eliminate the Nostrand Junction chokepoint and introduce a new service along Utica Ave. For these reasons, IPO #3 was selected as one of the Final Investment Packages.

Based on the ranking of IPOs #4-#7 in Task 4, IPO #5 was ranked as the best option for an A-Division Extension to Kings Plaza. In addition to eliminating the Nostrand Junction chokepoint, IPO #5 would provide high reliability and frequency for the subway lines terminating at Kings Plaza without degrading other A-Division services. The loss of a one-seat ride from Flatbush Av Terminal to the East Side of Manhattan would be offset by an increase in service frequency (enabled by the Modified Hybrid Operating Plan) in addition to an improvement in end terminal OTP. Moreover, IPO #5 was unique among the 13 IPOs as the only one that would provide a one-seat ride to both the East and West Sides of Manhattan from Kings Plaza, in addition to other benefits that were common to other IPOs with an A-Division Extension to Kings Plaza (e.g., travel time improvements to

destinations beyond the Study Area). For these reasons, IPO #5 was selected as one of the Final Investment Packages.

IPOs #10-#13 functionally served as the sibling IPOs to #4-#7 regarding A-Division operational performance. Specifically, the operational characteristics of the A-Division service for IPOs #10-#13 were identical to IPOs #4-#7 (in that order), except that the southern terminus along Utica Ave would be at Church Av (for IPOs #10-#13) instead of Kings Plaza (for IPOs #4-#7). As such, just as IPO #5 was ranked as the best option among IPOs #4-#7, IPO #11 emerged as the best option among IPOs #10-#13. In addition to the different southern termini along Utica Ave for the A-Division Extension, another key difference between IPO #11 and IPO #5 was that the former would also include BRT from Kings Plaza to Woodhull Hospital. Therefore, IPO #11 would achieve the corridor-wide benefits of introducing BRT along Utica Ave plus additional benefits associated with an A-Division Extension.<sup>35</sup> IPO #11 would also be a relatively cost-effective option for extending subway service south along Utica Ave because—when paired with BRT—this IPO would require a fraction of the capital cost compared to IPO #5 while also generating a greater number of new riders. Moreover, the A-Division Extension to Church Av as included in IPO #11 would not preclude a subsequent extension to Kings Plaza as included in IPO #5. For these reasons, IPO #11 was selected as one of the Final Investment Packages.

In contrast to the aforementioned IPOs, the IPOs with a B-Division Shuttle did not demonstrate benefits that would warrant the capital investment. IPOs #8 and #9 had the highest capital cost and—when compared to the number of new riders generated by the investment—the lowest cost effectiveness among all of the IPOs under consideration.<sup>36</sup> While a B-Division Shuttle would provide customers with frequent and fast service from Kings Plaza to Fulton Street, it would comprise an isolated line that would require customers to transfer to access A-Division or B-Division services (at Eastern Parkway or Fulton Street, respectively). Among all IPOs that would introduce a new service along Utica Ave, IPOs #8 and #9 generated the lowest number of linked trips on the project, both overall and by low-income households. It is important to note that while the IPOs with BRT would similarly require a transfer to access subway service, the estimated ridership for the BRT IPOs would vastly exceed that of the B-Division Shuttle IPOs with respect to new riders as well as linked trips on the project by low-income households. This was indicative of the ridership potential along the northern portion of the corridor (i.e., north of Fulton Street, including EJ communities), which would

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<sup>35</sup> As noted in “Task 3 Appendix 4: IPO Evaluation Results,” all IPOs with an A-Division Extension (regardless of the southern terminus location) would generate certain benefits in addition to the new service along Utica Ave. For instance, an A-Division Extension would improve Crown Heights-Utica Av Station operations because this station was not designed to function as a terminal. Furthermore, an A-Division Extension would create additional bus-subway transfer locations along Utica Ave, thereby creating an opportunity to shift some of the high boarding activity away from the busy intersection at Eastern Parkway.

<sup>36</sup> Additionally, as discussed previously, IPO #8 stood out for the significantly lower number of new riders compared to all other IPOs, as well as the extreme difference in the number of new riders relative to #9. Although IPOs #8 and #9 included the same service along Utica Ave, IPO #9 included the Modified Hybrid Operating Plan, thereby demonstrating the ridership benefits associated with the A-Division improvements that would enable the Modified Hybrid Operating Plan when holding all other variables constant.

be served by BRT but not the B-Division Shuttle. For these reasons, neither IPO #8 nor IPO #9 were included in the Final Investment Packages.

In summary, the Final Investment Packages—and corresponding order-of-magnitude capital cost estimates (in 2020 \$\$)—were as follows:

- **IPO #1** [REDACTED] A-Division improvements only (no new service along Utica Ave) with Modified Hybrid Operating Plan, supplementing the B46 SBS;
- **IPO #3** [REDACTED] BRT from Kings Plaza to Woodhull Hospital with Modified Hybrid Operating Plan on the A-Division;
- **IPO #5** [REDACTED] A-Division Extension via Local Track Connection from Eastern Parkway to Kings Plaza with Modified Hybrid Operating Plan; and
- **IPO #11** [REDACTED] BRT from Kings Plaza to Woodhull Hospital paired with A-Division Extension via Local Track Connection from Eastern Parkway to Church Av with Modified Hybrid Operating Plan.<sup>37</sup>

The four Final Investment Packages would all eliminate the Nostrand Junction chokepoint, thereby enhancing access to/from Utica Ave and enabling service improvements throughout the Brooklyn A-Division. The Final Investment Packages would also provide a range of options—and relative levels of capital investment—for improving mobility along Utica Ave, including BRT along the entire corridor in the Study Area, an A-Division Extension to Kings Plaza, and the pairing of BRT with a partial A-Division Extension (to Church Av). The four Final Investment Packages would differ with respect to the operational characteristics for transit service along Utica Ave as well as on the Brooklyn A-Division to Utica Ave, Flatbush Av Terminal, and New Lots Av Terminal. These operational characteristics served as inputs to the ridership model and were reflected in differences in the resultant ridership forecasts. Appendix 1 presents the corresponding ridership forecasts for each of the four Final Investment Packages paired with each of the three Land Use Scenarios defined earlier in the study.<sup>38</sup>

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<sup>37</sup> As previously noted, the capital cost estimates conservatively assumed a design-bid-build contracting method. The potential efficiencies that could be realized through a design-build contracting method were discussed in “Task 3 Appendix 5: Order-of-Magnitude Capital Cost & Construction Duration Estimates for the IPOs.” For IPOs #5 and #11, the range in capital cost estimates for both the underground and aerial alignment concepts correspond to different options for the Local Track Connection at Eastern Parkway. The specific alignment options could be revisited in a subsequent design phase.

<sup>38</sup> At the request of the City partners, ridership forecasts were also prepared for IPO #4 paired with each of the three Land Use Scenarios, for comparison with the infrastructurally similar IPO #5, although IPO #4 was not recommended as one of the Final Investment Packages.



All of the Final Investment Packages offer opportunities for phased implementation, regardless of whether the respective IPO would feature targeted improvements to the A-Division, a new service along Utica Ave, or both types of improvements. For instance, the A-Division improvements that are common to all of the Final Investment Packages could be constructed sequentially to prioritize the investments at Crown Heights-Utica Av Station that would address critical chokepoints in the system (i.e., at Nostrand Junction) and increase operational flexibility, followed by the complementary improvements to increase terminal capacity at New Lots Av Terminal and Flatbush Av Terminal. Additionally, the IPOs that would introduce a new transit service along Utica Ave could start with an initial operating segment to build ridership prior to implementing the full service. These opportunities for phased implementation could be considered in greater detail in a subsequent design phase for any of the Final Investment Packages.

## 7 Conclusion

Building upon the work in previous tasks, this Task 5 report has documented the process of selecting the Final Investment Packages in the Utica Ave Study. Each of the Final Investment Packages would achieve the study goals and objectives and address the need for transit improvements to increase reliability, reduce travel times, enhance connectivity, and accommodate future growth. In summary, the targeted comparison of the IPOs defined in this study led to the selection of four Final Investment Packages, which effectively encompass a wide range of investment levels and concepts for further consideration that could improve transit service along, to, and from Utica Ave.

## Appendix 1: Glossary of Key Terms

The following glossary is presented alphabetically and provides a high-level description of key terms used in the Task 5 report. The glossary is not intended to offer technical definitions, but rather to establish background context about the evaluation of different transit improvement alternatives as part of the Utica Ave Study.

- **A-Division:**

- Subway services denoted by numbered routes, with the Brooklyn A-Division corresponding to the trains that terminate at Flatbush Av Terminal, New Lots Av Terminal, and Crown Heights-Utica Av Station (in the No-Build Alternative, with consideration for other terminal locations along Utica Ave in conjunction with an A-Division Extension as part of this study).

- **A-Division Extension:**

- An alternative under consideration this study that comprises a subway extension south along Utica Ave from Crown Heights-Utica Av Station with through service that would enable a one-seat ride from Utica Ave to/from Manhattan and other locations along the A-Division. Several options for an A-Division Extension were under consideration in the study, including different combinations of the track connection at Eastern Parkway (Local or Express), the southern terminus along Utica Ave (Kings Plaza or Church Av), and the corresponding A-Division operating plan (CBTC Baseline or Modified Hybrid).

- **A-Division Improvements:**

- Infrastructure investments that could enable an increase in capacity and/or operational flexibility, with a focus in this study on improving access to/from Utica Ave while avoiding a degradation of other A-Division services in Brooklyn. Five A-Division improvements were recommended in this study, including three improvements at Crown Heights-Utica Av Station and one each at Flatbush Av Terminal and New Lots Av Terminal.

- **A-Division Operating Plan:**

- Subway service on the A-Division as reflected in the split of peak trains per hour (TPH) by line and terminal. The two A-Division operating plans that were advanced for analysis in the Utica Ave Study (i.e., the CBTC Baseline and Modified Hybrid Operating Plans) offered different services to Flatbush Av Terminal, New Lots Av Terminal, and a terminal along Utica Ave, the location of which would differ among the transit improvement alternatives under consideration (i.e., Crown Heights-Utica Av Station, Church Av, or Kings Plaza).

- **B-Division:**
  - Subway services denoted by lettered routes. B-Division service is provided to/from the Study Area along the Fulton Street Line (A C at Utica Av Station) and the Broadway Line (J M Z at Myrtle Av Station in addition to local service at Kosciuszko St and Gates Av).
- **B-Division Shuttle:**
  - An alternative considered in this study as an option to provide subway service along Utica Ave to Fulton Street (with the prospect of a future northward extension to Broadway) because a B-Division Extension with through service was deemed to be fatally flawed due to capacity constraints. The B-Division Shuttle concept constituted an isolated line that would require customers to transfer to access other subway services.
- **Bus Rapid Transit (BRT):**
  - A modal option for a new transit service along Utica Ave that would comprise full physical separation from traffic, thereby improving travel time for customers by avoiding problems that degrade B46 SBS service (e.g., double parking and bus bunching). Additionally, the BRT would provide service to both the Myrtle Av Subway Station and Woodhull Hospital, beyond the northern terminus of the B46 SBS.
- **Communications-Based Train Control (CBTC):**
  - A signaling system that offers train dispatchers more accurate train location information, allows for closer spacing between trains, enables increased reliability, and has the potential to increase the number of trains running on each line compared to fixed-block signaling. The No-Build Alternative in this study included the installation of CBTC on the A-Division.
- **CBTC Baseline Operating Plan:**
  - One of the A-Division operating plans under consideration in the Utica Ave Study. Without an A-Division Extension along Utica Ave, the CBTC Baseline Operating Plan corresponded to the No-Build Alternative for A-Division operations in this study. Of note, the Nostrand Junction chokepoint would continue to exist with the CBTC Baseline Operating Plan due to merging and diverging moves of the 2 and 5 to serve Flatbush Av Terminal.
- **Environmental Justice (EJ) Communities:**
  - Areas of relatively large percentages of minority and/or low-income populations compared to a reference area (e.g., Brooklyn or New York City). Both the Primary and Secondary Study Areas are considered EJ communities with respect to minority population, and the Secondary Study Area is also considered an EJ community with respect to low-income population. The “Task 3 Appendix 7: Environmental Scan Along Utica Ave” should be consulted for more information, including details about the methodology for defining EJ communities based on federal and state guidance.

- **Final Investment Packages:**
  - A subset of the 13 IPOs defined in this study, encompassing a range of investment levels and concepts for further consideration (including opportunities for phased implementation) that could improve transit service along, to, and from Utica Ave. The culmination of the study was the selection of four Final Investment Packages, all of which included the Modified Hybrid Operating Plan on the A-Division, which would eliminate the Nostrand Junction chokepoint. The Final Investment Packages differed with respect to the new transit service that would be introduced along Utica Ave (if any) to replace the B46 SBS, including BRT, an A-Division Extension (to Kings Plaza), and the pairing of BRT with a partial A-Division Extension (to Church Av), in addition to an option that would continue to include the B46 SBS without a new service on Utica Ave.
- **Investment Package Options (IPOs):**
  - A representative set of concepts for new transit service along Utica Ave paired with an associated A-Division operating plan. A total of 13 IPOs were defined and evaluated in the study, and the screening process resulted in the selection of four Final Investment Packages for further consideration.
- **Land Use Scenarios:**
  - Three hypothetical scenarios for Utica Ave—contingent upon transit improvements—that represented incremental increases in population and employment, which served as key inputs to the ridership model in this study. The Land Use Scenarios reflected different ridership potential when paired with the Final Investment Packages.
- **Modified Hybrid Operating Plan:**
  - One of the A-Division operating plans under consideration in the Utica Ave Study. The Modified Hybrid Operating Plan—enabled by A-Division improvements—would eliminate the Nostrand Junction chokepoint and accommodate an increase in peak service delivery on the Brooklyn A-Division compared to the CBTC Baseline Operating Plan. When paired with an A-Division Extension, the Modified Hybrid Operating Plan would introduce a new **8** line to enable West Side service to New Lots Av Terminal (for the Express Track Connection) or along Utica Ave (for the Local Track Connection).
- **No-Build Alternative:**
  - The baseline for comparing the anticipated benefits and potential impacts of transit improvement alternatives in the Utica Ave Study. The No-Build Alternative was defined to include changes to the transportation network expected to exist in the 2035 horizon year, such as Long Island Rail Road (LIRR) East Side Access, Metro-North Railroad Penn Station Access, and Phase 2 of the Second Avenue Subway. The No-Build Alternative also included improvements to travel times and average headways on the A-Division due to the installation of CBTC, as well as a number of capital improvements and operational changes to enhance the existing B46 SBS.

- **Nostrand Junction Chokepoint:**

- The short section of track (less than 200 feet) that is shared by the 2, 3, and 5 and accommodates the merging and diverging moves of the 2 and 5 to serve Flatbush Av Terminal. This short section of track caps the maximum frequency of these services, requires that their schedules be closely linked, and introduces additional delay when there are schedule deviations.

- **Screening Process:**

- A multi-tiered process to evaluate various modal and alignment options on Utica Ave and capacity improvements in the existing subway network—resulting in the selection of a set of Final Investment Packages for further consideration—to increase mobility and accessibility along, to, and from the Utica Ave corridor for a future horizon year 2035.

- **Study Area:**

- An area extending from Avenue V in the south to Myrtle Ave in the north and incorporating an approximately half-mile buffer around the Utica Ave corridor, which becomes Malcolm X Boulevard north of Fulton Street. The Study Area was divided into Primary and Secondary Study Areas, with the Primary Study Area (between Avenue V and Eastern Parkway) serving as the main focus in the study of options to improve transit service and mobility along the Utica Ave corridor, and the Secondary Study Area (between Eastern Parkway and Myrtle Ave) containing additional opportunities for transit improvements along the northern portion of the corridor.